MEASUREMENT OF SELF-EFFICACY, PREDISPOSITION FOR COLLABORATION, AND PROJECT SCORES IN ARCHITECTURAL DESIGN STUDIOS

A Dissertation

by

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ABSTRACT

The design of high-performance, sustainable, built environments in architectural practice is becoming more collaborative, and the demands on architectural education to provide measurable learning outcomes that more successfully prepare students to contribute in a practice setting are increasing. Since educational experts assert that self-efficacy is a key attribute of successful students and architectural education relies heavily upon project-based learning in design studios, it is a reasonable expectation that the character and quality of architectural design studio courses may affect the development of Design Self-Efficacy. This research has developed instruments by which instructional methods, self-efficacy, and student projects may be measured and scored, enabling reliable and valid investigation of the relationships among these factors.

This dissertation has three primary foci: (1) developing an instrument to measure student Design Self-Efficacy and predisposition to collaboration in design studios; (2) developing a framework for better understanding how studio type and project type impact Design Self-Efficacy, and (3) developing an instrument employing an assessment rubric to measure student learning outcomes through end results of a Project Score.

Data was collected from Texas A&M University, the University of Kentucky, and the University of Kansas via content analysis of studio syllabi; focus groups and interviews with faculty; electronic surveys of students enrolled in architectural design studios; and the assessment of projects using a validated rubric. This research included the development and calibration of measurement instruments to determine if correlation exists between Design Self-Efficacy (DSE), disposition for collaboration (PD), studio-type (ST), project-type (PT), and project score (PS).

Research revealed that PD is sensitive to different students and different moments in time. The DSE instrument produced results that aligned to self-efficacy theory and data analysis revealed increased self-efficacy from undergraduate through graduate studies, and theoretical groupings that parallel the processes of design studio problem solving, project development, iteration, evaluation, and communication. The PS data analysis revealed gaps in architectural design studio evaluations that can be addressed with an assessment rubric.

The results of this dissertation serve as a foundation for a future research agenda to improve design education, inform the accreditation process of professional architecture programs in North America and by extension, impact the practice of architecture.

DEDICATION

This dissertation is dedicated to my daughter, Miller Rigault Luhan and in memory of my son, Ethan Wittmann Luhan.

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NOMENCLATURE

SE	Self-efficacy
DSE	Design Self-Efficacy
DSE-M	Design Self-Efficacy Mastery Experiences
DSE-V	Design Self-Efficacy Vicarious Experiences
DSE-S	Design Self-Efficacy Social Persuasion Experiences
DSE-P	Design Self-Efficacy Physiological Experiences
PS	Project Score
PT	Project Type
ST	Studio Type
PD	Predisposition for Collaboration
GPA	Grade Point Average
ANOVA	Analysis of Variation
AAC&U	Association of American Colleges & Universities
AIA	The American Institute of Architects
AIAS	The American Institute of Architecture Students
NAAB	National Architectural Accrediting Board
CIDA	Council for Interior Design Accreditation
NCARB	National Council of Architectural Registration Board
ACSA	Association of Collegiate Schools of Architecture
SPC	Student Performance Criteria

SLO	Student Learning Outcomes
LAT	Learning Achievement Tools
IRB	Institutional Review Board
IE	Office of Institutional Effectiveness
TAMU/A&M	Texas A&M University
KU	University of Kansas
UKY	University of Kentucky
Qualtrics	Qualtrics Online Survey Software & Insight Platform
BIM	Building Information Model

TABLE OF CONTENTS

Page

Page

Page

Page

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

CHAPTER I

INTRODUCTION

Architectural education has long relied upon the design studio course to convey professional competence and behavior; however, rigorous research to determine whether those educational methods are truly effective is rare. This dissertation presents an investigation that has produced instruments for measuring the effectiveness of design studio courses and architectural curricula with respect to learning outcomes, student project scores, and acquisition of self-efficacy by students. This chapter is an overview of the research study and guiding questions informed by eighteen years of informal observations in the studio setting. These observations have identified a gap in knowledge that this dissertation addresses. This chapter will also outline the motivations for the research as well as the purpose of the study.

I.1 Problem Statement

Arguably, the goal of professional education is to prepare individuals to enter a profession as productive, capable, and confident practitioners, preparing them for the next step to become licensed professionals. This goal is similar to the concept of self-efficacy, which has been defined as the "belief in one's capabilities to organize and execute the courses of action required to manage prospective situations" (Bandura, 1995). Research demonstrates that self-efficacy can be predictive of future achievement, triangulating among a student's motivation for learning, the student's belief in his or her own ability, and the student's actual deep knowledge of the field (Zimmerman, 2000).

Although there is existing research in engineering (Mamaril, 2014) and mathematics (Usher, 2007) that indicates a strong relationship between self-efficacy and academic achievement, these capabilities are generally left unmeasured or ill-defined in the architectural design studio context. Currently, there is no measurement instrument of self-efficacy in the context of architectural design studios where students work in a variety of settings—individually or in teams—on creative hypothetical or real projects. In light of this, it is important to understand whether and how self-efficacy results from architectural education. This dissertation addresses these recognized gaps and extends knowledge for measuring self-efficacy into the architectural design studio context. Furthermore, it explores the correlation of self-efficacy to studio type, project type, and project score to reveal whether self-efficacy is a predictive measure of architecture student success in project-based initiatives.

I.1.1 Guiding Questions

This dissertation relies upon the assumption that self-efficacy is a metric for measuring student success in the architectural studios. This research is formulated around two primary research questions:

1. Does the architecture design studio context influence self-efficacy?
2. Do collaborative projects increase self-efficacy?

It may be presumed, that if a student's appraisal of self-efficacy is accurate, then upon graduation he or she will be more productive and more capable of joining architecture firms (regardless of firm size) with a higher degree of ability to collaborate compared with students who do not have high and accurate self-efficacy. If course content on collaboration improves students' self-efficacy, then it should be credited with equipping them to be better professionals.

I.1.2 Informal Observations

Architecture education is comprised of a variety of teaching modalities: lecture classes, seminars, and design studios. Each of these methods enable critical approaches to writing, speaking, and thinking that serve as the foundational underpinnings of student development and align with Bloom's Taxonomy (Bloom, 1956) for categorizing educational goals. These goals include remembering, understanding, applying, analyzing, evaluating, and creating (Figure I.1). According to Bloom (1956), the highest level of expertise is creating. At this level the student is required to synthesize a variety of constraints, utilize skills, and generate solutions.

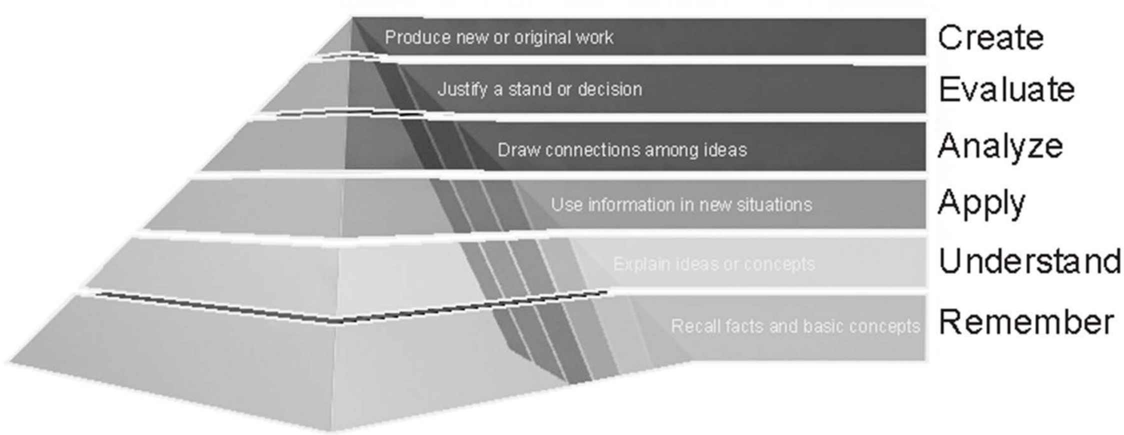

Figure I.1: Bloom's Taxonomy (1956).

It is within this aspiration of creativity that project-based learning of the design studio pedagogy is the most formative. Educating students through pedagogical methods that include problem-solving approaches such as design-thinking and systems-thinking enables students to simultaneously see issues and design constraints from multiple vantage points. This allows them to work on increasingly complex architectural projects that do not have easily derived solutions. These factors point to a recognized gap in research about educational practices that could better prepare students in their formative years of design education for professional practice. By simulating and testing real-world complexities where students share information and expertise within and across disciplines, students may be able to achieve goals more efficiently, generate better and more comprehensively developed ideas, and increase their ability to collaborate (Mintzberg et al., 1996).

Increasing students' experience in collaborative design projects may increase a student's self-awareness of ability and thus increase belief in the student's own capabilities. Collaborative projects enable a student to take on a unique role within the team, gaining recognition and appreciation from peers. This increased knowledge could arguably lead to greater professional success and produce societal advantages for the communities graduates serve. If increasing self-efficacy is important, then it follows there is a need to develop an instrument that will measure self-efficacy so that students can be better prepared for "meaningful design collaborations in the professional realm" (Olsen & MacNamara, 2014).

Some researchers suggest there is need to better understand how students working on interdisciplinary project design teams learn to collaborate (Schaffer et al, 2012) and how their ability to collaborate affects project outcomes. Informal evidence suggests that successful quasi-real projects, to use a term coined by V. Miranda

(Personal Communication, 05 May 2014) for academic projects that involve clients from industry, enable students to produce artifacts that are comparable to those produced in industry. These types of projects positively impact the communities that they address, as well as the students who participated in them. Examples of quasi-real projects include the US Department of Energy-sponsored Solar Decathlon (http://www.solardecathlon.gov) and the ACSA-recognized Collaborative Practice and Design-Build studios (http://www.acsa-arch.org/programs-events/awards/archives)—Rural Studio at Auburn University (http://www.ruralstudio.org), Studio 804 at the University of Kansas (http://www.studio804.com), Design/Build Lab at Virginia Tech (http://www.designbuildlab.org), and Design/Build Bluff at the University of Utah (http://www.designbuildbluff.org) projects, as well as those recognized with the National Council of Architectural Registration Board sponsored NCARB Award for the Integration of Practice and Education (http://www.ncarb.org/Studying-Architecture/NCARB-Award.aspx).

It is theorized that understanding student self-efficacy in the design studio context should result in the generation of creative, comprehensive, and integrated design pedagogy (Luhan & Gregory, 2013) and therefore, potentially influence architecture school policy and help shape future student performance standards.

I.1.3 Motivation

It is the intent of this dissertation to examine if there are correlations among student self-efficacy, predispositions for collaboration, the type of project that a student develops or is tasked with addressing, the context in which students work, and academic achievement. The motivation for this work is to enhance student self-efficacy and enable graduates to better address significant societal challenges related to the built environment such as energy efficiency and generation, climate responsiveness, transportation networks and infrastructure, and resource efficiency. It seems reasonable that confronting students with messy, real-world problems that differ from carefully formulated hypothetical textbook coursework could lead to increased self-efficacy and predisposition to collaborate in students who successfully completed the project. However this research is focused on establishing the framework that would enable this kind of study.

I.1.4 Purpose of Study

The purpose of this research is to measure self-efficacy through a critical analysis of design studios and understand its relationship to architecture student success through a critical analysis of design studios. This analysis will produce two results: (1) a determination of whether hypothetical, interdisciplinary, collaborative, integrated, or real projects that are completed individually or in teams influence student self-efficacy or predisposition to collaborate, and (2) if a well-developed and clear rubric for student learning outcomes can be used by external jurors to produce consistent student learning and course assessments. If these appear to be true, then this study could positively direct future design course pedagogy and the methods of developing and assessing student work.

This research has:

- Developed, tested, and validated measures of design students' self-efficacy and predispositions to collaborate
- Identified differences in studio type and project type and its impact on Design Self-Efficacy and predispositions to collaborate
- Investigated whether National Architectural Accrediting Board (NAAB) Student Performance Criteria (SPC) and studio learning objectives are tied to Design Self-Efficacy and how they relate to project score as determined by the research design rubric

The specific contributions of this research are:

- A measurement tool for assessing design student self-efficacy in architecture studios validated using authoritative sources, compelling argument, and qualitative evidence
- A basis for determining whether, and to what extent, self-efficacy is an effective heuristic for measuring student success across studio types where students work on varied project-based assignments
- A method for classifying studio courses by project type and studio type
- A well-defined method and rubric for assessing student learning outcomes in design studios across a range of studio and project types
- A validated and objective measure of project score
- Determination of correlations across design studio type, project type, predisposition to collaborate, self-efficacy, and project score

- Disciplinary insights into architectural design studio education
- Correlation between Design Self-Efficacy and Demographics related to Gender, Race and Ethnicity.

I.2 Research Scope

Self-efficacy has not been measured in architectural design studios; consequently, there is limited empirical knowledge about self-efficacy in design studios and how students assign value or self-critique their creative capabilities. A quantitative investigation would provide key insights into this realm and offer additional insights into the mechanisms of teaching, learning, and generating design solutions. This dissertation focuses on three primary tasks: first, developing an instrument to measure Design Self-Efficacy and predisposition to collaborate in architectural design studios; second, developing a pedagogical framework for better understanding how design studios, regardless of studio type and project type impact Design Self-Efficacy, and third, developing an instrument employing an assessment rubric to measure student learning outcomes through end results of a project score.

The research design utilized by this study examines all levels of design studio courses where students work individually or collaboratively, within or across disciplines, on simple or complex, hypothetical or real-world, unbuilt or built projects (Figure I.2). This research develops a framework for design pedagogy that could, as M.J. Clayton stated, "break the logjam in our educational and disciplinary culture that currently prevents us from innovating, adapting, and leading (Personal Communication, 19 September 2013)." This research uses methods that could move design education out of the predominantly tacit knowledge realm into an explicit, technical realm. Therefore, it will serve as a major step toward objective measurements that assess pedagogical effectiveness as relates to design student self-efficacy.

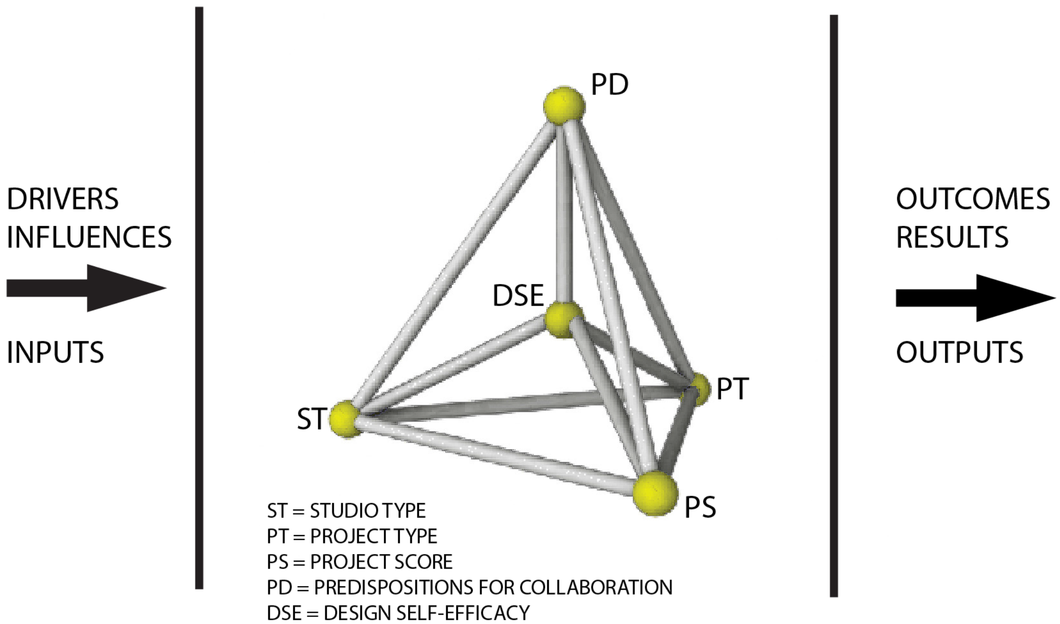

Figure I.2: Scope of Research Study – ST, PT, PS, PD, and DSE.

I.3 Significance of Research and Contribution

By simultaneously studying self-efficacy across all types of studios and projects, this research lays the necessary foundation for studying integrated, collaborative, and interdisciplinary team-based methodologies similar to the professional context that students will encounter upon graduation. It provides a baseline measurement for future studies to reveal key measurable factors that relate to NAAB SPC and more subtle impacts upon student learning in the design studio.

I.3.1 Intellectual Merit

This dissertation contributes to the academic and professional community by expanding the existing body of knowledge in three areas: academic theory, academic practice, and professional practice praxis. An understanding of the relationship between teaching methods and their link to self-efficacy and learning outcomes can improve design education. Pedagogy in design studios can incorporate this psychometrically sound instrument to detect architectural self-efficacy. This research contributes to literature on integrated studio curriculum, collaboration, and self-efficacy in project-based inquiry. The results of this investigation could also influence other disciplines that use project-based inquiry.

I.3.2 Broader Impacts

The research promotes a framework of multiple measurement instruments for design education that provides a holistic diagnostic for identifying both educational efficiencies and deficiencies in architectural design studios. These instruments could be used to inform an impactful, market-responsive, individualized learning program that directly benefits society and informs academic pedagogy. Furthermore, because the research was tested at three design programs, the measurement instrumentation could be disseminated to other institutions and provide a more generalized understanding of design studios while promoting parallel assessment for other courses. Demographic insights gained by this study could align with a deeper understanding of how to better serve under-represented groups. Knowledge gained by this research could impact curriculum for outreach projects that promote community engagement and problem solving. This research can be used to promote teaching and learning that further inform emerging models of practice, therefore benefitting the discipline and practice of architecture, its related technology and infrastructure, and, by extension, society as a whole.

I.4 Overview of Chapters

The chapters of this dissertation are ordered logically to construct an argument for the conclusions and contributions.

The *Review of Literature* has four subchapters: architectural design education, self-efficacy, collaboration, and project scoring. Subchapter 1 describes the context and content of architectural design education: studio pedagogy, studio typology, and project typology. Subchapter 2 explores the study and application of self-efficacy in STEM-related fields from authorities A. Bandura through F. Pajares to E. Usher who formulated the concept and its application. Subchapter 3 examines a method for assessing individualism and collectivism as predispositions for collaboration and how collaboration facilitates understanding in the design studio. Subchapter 4 examines the issues in scoring student projects. These subchapters serve as the points of departure for the research methodology for assessing creativity.

The *Research Methodologies* chapter provides a listing of hypotheses and a comparison of the various research methods leading to the selection of the methods used to test the hypotheses in this research. It describes the development of various instruments and their validation and calibration. It presents the research instrumentation including the self-efficacy survey, syllabi content analysis, focus groups, interviews with faculty, rubric development, and project review and assessment. This chapter also discusses the pilot test results and impact on the final study, assumptions, limitations, and delimitations of the research.

The *Data and Observations* chapter presents a summary of the data collected in the research and the descriptive statistics of the observed sample. This chapter concludes with a summary of the data and observations that informed the analysis of the data.

The *Data Analysis* chapter outlines the instruments developed for the research used in the hypotheses testing, arguments for reliability and validity of the research design, and the inter-rater reliability measures of the project scoring. The contributions and claims of the research are also presented through visual and statistical inferences with supporting facts drawn from the analysis.

The *Conclusions* chapter discusses the main findings, implications, and contribution of the study and outlines areas of *Future Research* beyond the dissertation.

The dissertation concludes with *References* and *Appendices.* The reference section refers only to the research cited in the dissertation. The appendices include the approved IRB applications for Texas A&M University and the University of Kentucky, letters of support from Texas A&M University, the University of Kentucky, and the University of Kansas, the DSE survey instrument, the rubric mapping of learning outcomes to accreditation standards, syllabus content analysis and project scoring rubrics, and the comprehensive analysis of data obtained through the study.

CHAPTER II

LITERATURE REVIEW

The overarching objective of this study is to investigate the relationships between the context and content of design studio pedagogy, a student's predisposition for collaboration, and individual and collective influence on design student self-efficacy and academic achievement (for this study defined as project score). This chapter provides a critical review of selected literature pertaining to self-efficacy, architectural design studio education, collaboration, and project scoring. The review of literature establishes the theoretical underpinnings for the research design, its theoretical basis, content of prior work, and a logical argument for the dissertation.

II.1 Overview of Literature

This chapter has four subchapters. The first subchapter presents self-efficacy used in academic contexts of communication, engineering, and mathematics as a foundation for instrumentation for assessing self-efficacy in the study. The second subchapter describes the context and content of architectural design studio education: studio pedagogy, studio typology, and project typology. The third subchapter explores both individual and collective vantage points to better understand the impact within and beyond the academic context as predictors for this study. The fourth subchapter offers a review of findings from investigations for assessing creativity and student design work. Collectively, this review of literature serves as a foundation to support the points of departure for the research methods used in the dissertation.

II.2 Self-Efficacy

Self-efficacy is “not a measure of the skills that one has but a belief about what one can do under different sets of conditions with whatever skills one possesses” (Bandura, 1997). Self-efficacy actively links motivation to learning and to doing in any given domain, discipline, context, or situation (Bandura, 1997). This concept is inevitably connected to design education where students work individually or collaboratively on a range of projects and upon graduation often follow a path to licensure and professional practice. Bandura’s theoretical assumptions for self-efficacy are constructed from four primary experiential sources: mastery experiences, vicarious experiences, social persuasion, and physiological affective states (Bandura, 1997). The task-specific mastery experiences are based upon confidence developed from previous successes and the perceived value associated with the challenges faced while completing tasks. Vicarious experiences rely on secondhand interactions that are observed and then informed by modeled behavior and guided influence, whereas social persuasion are influenced through verbal, visual, and mentoring techniques that facilitate action. Both vicarious experiences and social persuasion can be activated through supportive motivation, comparative feedback, and integrated assessment that are internalized to produce an incremental success or a change in behavior. Physiological affective states are influenced by the stress, anxiety, and fatigue that result from being assessed or comparatively judged on their capabilities or successes while completing tasks. These four types of experiences contribute to the acquisition of self-efficacy, but they are not in themselves measures of self-efficacy. Research demonstrates that of the four types of experiences mastery experiences are the most significant source of self-efficacy because they produce what Artino refers to as “authentic evidence” that demonstrates that a person can succeed in a given situation (Artino, 2012). Further, Bandura states, a person’s successes “build a robust belief in one’s personal efficacy, whereas failures undermine it” (Bandura, 1995). In the context of design studios, failure is a critical aspect of the design process where the design thinking mantras of think differently, fail fast, and fail forward result in learning from failures and thus produce better and more effective results (Kelley & Kelley, 2013).

The predictive effect of self-efficacy on a student’s academic achievement has been researched extensively in the academic setting. Empirical research demonstrates that self-efficacy is a good predictor of student success and triangulates among a student’s motivation for learning, their belief that they can solve problems, and their link to both learning and learning outcomes (Zimmerman, Bandura, & Martinez-Pons, 1992). Self-efficacy is “critical to a student’s academic functioning and well-being” (Usher, 2007). Studies suggest “When studied as a mediating variable in training studies, self-efficacy has proven to be responsive to improvements in students’ methods of learning (especially those involving greater self-regulation) and predictive of achievement outcomes” (Zimmerman, 2000).

To meet real-world demands as future professionals, design students need to develop self-efficacy (creative self-confidence) (T. Kelley & D. Kelley, 2013) in order to collaborate effectively with their interdisciplinary stakeholder partners. To be successful professionals, students must “not only gain confidence in their abilities” but be prepared for “meaningful design collaborations in the professional realm” (Olsen & MacNamara, 2014). Research demonstrates that effective teamwork requires personal agency (Vallacher & Wegner, 1989) and collaboration (Pressman, 2014).

II.3 Architecture Design Studio Education

As described in the overview of architectural education by the Association of Collegiate Schools of Architecture, the education of architecture students in North America includes two essential components – a general liberal arts education and a specific professional education (http://www.acsa-arch.org/resources/student-resources/overview/architectural-education). The end product of the educational process is a broadly educated design student. The intent of this structure supports the findings of *The Boyer Report*—to provide each student with the necessary foundations for critical thinking, technical knowledge, communicative acumen, and design skills—so that graduates can positively inform the built environment and impact the communities that architects serve (Boyer & Mitgang, 1996). To achieve this goal, professional programs of architecture are required to meet two forms of accreditation: a recognized regional accrediting agency for the given institution and the National Architectural Accrediting Board (NAAB) for the domain of architecture. NAAB stipulates the student performance criteria (SPC) that must be met by a given program of architecture as well as the cognitive level of accomplishment—understanding or ability (NAAB, 2014).

The NAAB Student Performance Criteria (SPC) separate into four educational realms: Critical Thinking and Representation; Building Practices, Technical Skills, and Knowledge; Integrated Architectural Solutions; and Professional Practice. NAAB requires an accredited program to produce graduates that “are competent in a range of intellectual, spatial, technical, and interpersonal skills; understand the historical, socio-cultural, and environmental context of architecture; are able to solve architectural design problems, including the integration of technical systems and health and safety requirements; and comprehend architects' roles and responsibilities in society” (NAAB, 2014). However, NAAB does not dictate how the program achieves those criteria, enabling each program to determine how and where to meet the stated SPC learning objectives within its own curriculum framework (Appendix 02).

The typical pedagogical structure enabled by this educational flexibility usually requires an amalgam of theoretical and hands-on courses that take the form of history, theory, technical, and design studio courses (NAAB, 2014). Whereas, the majority of courses that students take are 3 credits hours and meet for 2.5 to 3 hours per week, the studio courses usually range from 5 to 9 credit hours, require ten to twelve faculty contact hours per week, and last for 12 to 15 weeks of a semester depending upon the institution and level of the studio. The design studio is a sequenced course of instruction where students learn to solve problems with creative conclusions within a given time frame. Studio courses are the heart of architectural education and the backbone of the design curriculum (Koch, 2002). The studio topics work across a variety of scales and modes of representation and generally increase in complexity as the student shifts from first-year to upper-level curriculum in both the bachelors and masters degree granting programs. Typically, there are 8 to 12 required studios in a design curriculum, depending upon the course of study. While the numbers of credits and numbers of studios may vary from institution to institution, the studio context remains the primary venue for creative experimentation and discovery (Ockman & Williamson, 2012) within the academy.

Given the credit hour difference when compared to other courses, the time demands of the studio structure, its weighted importance in the curriculum, the reported inadequacies of the design studio setting (rigidity, lack of flexibility, time commitment, all-nighters, etc.), and the counterproductive and potentially demoralizing aspects of the formal design jury reviews as detailed in Kathryn H. Anthony's *Design Juries on Trial: the Renaissance of the Design Studio* (Anthony, 1991) in 2002, the American Institute of Architecture Students (AIAS) developed a task force to investigate the studio culture with architecture schools. The goal of the task force was to take a critical look at all facets of the studio and to establish both a formative and summative assessment that could better align the delivery of the design studio with the realities of practice by responding to the current pressures that face students in academia today. The AIAS report calls for a studio culture imbued with "five essential values: optimism, respect, sharing, engagement, and innovation" (Koch, 2002). Integrating these values into the curriculum programs will enable greater student confidence with empathy that informs both the student and the community they serve. In 2005, the National Architectural Accreditation Board (NAAB) requested all schools develop a Studio Culture Policy that makes the pedagogical benefits of the studio experience explicit. In direct response to the AIAS report and the NAAB request, accredited programs of architecture formulated strategies to achieve a shared culture that fit their unique pedagogical initiatives and to create a respectful learning environment (NAAB, 2014).

As noted above and reaffirmed in the Texas A&M Studio Culture Policy (Appendix 01) “design studio is a central component of an effective education in architecture.” A critical element to the effectiveness of the studio environment is the subjective nature of the creative process (Katz & Giacommelli, 1982). Design, in general, requires iteration, testing, and development over time that results in end products that may be an object or a building. In this iterative project-based context, projects develop and advance through dialogues inside and outside of the studio. The dialogues between the individual student and the faculty occur inside of the studio through desk-crits and informal studio pin-ups, or in peer-to-peer student exchanges. The dialogues between individual and collective groups of students occur outside of the studio in a professional juried review where design professionals, industry partners, and community officials offer professional or stakeholder insights in a public forum. These types of exchanges, whether inside or outside of the design studio, align with the Constructivist Theory advocated by D. Schön as: Reflection-in-practice, Reflection-in-action, and Reflection-on-action (Schön, 1983). As noted by Schön, “architecture functions as a prototype for design in other professions” where students learn to organize information, plan and design using hypothetical or real constraints, and learn from others. This type of “engaged learning” enables the student to harness the “collective intelligence” in ways that influence and effectively close the cycle of learning for the students (Sellnow, 2015). For Schön, this learning process separates into three distinct but intertwined operations: discovery, analysis and response, and evaluation. The components of discovery include both intended and unintended consequences or results that emerge from the rigorous creative project development. In this phase, students recognize design opportunities by correlating prior skills, personal knowledge, or life experiences with design precedents, new skill acquisition, knowledge application, and design experimentation. The results of this process are then iteratively developed in the analysis and response phase by scrutinizing their initial creative insights with lessons learned from the discovery phase. The student, through conversations with the faculty and colleagues, formulates new design challenges that Schön refers to as "back-talk" or emergent lessons enabled by learning-by-doing. The discovery and analysis phases continue through an evaluation phase where students rethink and integrate new actions and/or approaches (Schön, 1987).

II.3.1 Studio Pedagogy

The models of studio education have varied over the last one hundred years of architectural education. These variations in curricular structure represent ideological, practical, and theoretical shifts in the training and education of the design student and how that education could best be achieved (Ockman & Williamson, 2012). The curricular frameworks span from the master/apprentice models of the atelier through the formal training of the École des Beaux-Arts, the multi-faceted, artistic design approaches of the Bauhaus (1919-1933), through the environmental design approaches in the 1960s and 1970s, to the theory-based models of the 1990s to the computationally-intensive fabrications today (Ockman & Williamson, 2012). The topical debate between education and training is equally evident in the push-pull between the academy where students are educated and the profession where graduates are hired (NCARB, 2013). Influential educator Colin Rowe states that "the purpose of architectural education—as of all education—is not alone to train a student for professional occupation, but it is above all to grasp the nature and meaning of architecture, develop intellectual faculties, stimulate intellectual growth, equip students with knowledge and skills to practice, and to enable through education the powers of selection to exercise judgment" (Caragonne, 1995). Despite the fluctuations in the context and content of the studio, there is consensus that the design studio is an "environment of simulation or constructed reality" that is uniquely different from the realm of architectural practice (Cuff, 1991). The history, theoretical positions, and practice suggest that studio-based education encompasses a variety of learning-by-doing methods and strategies.

II.3.2 Studio Type

For this research, studio type is defined as the context of student learning, specifically the degree of collaboration. It ranges from totally independent to totally in teams (Lueth, 2008). An integrated studio pedagogical model requires both situated learning and actively engaged teaching approaches. In searching for approaches that stimulate innovation solutions, faculty can "learn from industry" and apply an integrated practice framework that is collaborative and interdisciplinary (Iordanova et al, 2010).

A focus on collaboration is motivated by the position that graduates need to be accomplished at teamwork, critical thinking, problem-solving, and oral and written communication (Boyer, 1996). The *Princeton Report* (Geddes & Spring, 1967) and the *Architectural Education: 1990 Report* (Romieniec, 1969) define these skills as the hallmarks of the architectural studio educational framework and also serve as the defining perspective for collaboration and leadership by the 2014 NAAB Conditions for Accreditation and its corresponding Student Performance Criteria (NAAB, 2014). As stated by an authority on leadership, “with the speed of change today, you cannot learn everything by yourself. If you want to stay up-to-date, you have to learn from other people. Collaboration affords us that opportunity” (Blanchard, 2012). Research demonstrates that effective teamwork requires collaboration (Pressman, 2014). Evidence further supports that effective teamwork will achieve goals more efficiently, generate more developed ideas and increase the effectiveness of collaboration on projects (Mintzberg, et al, 1996).

There is a clear need to better understand how students learn to collaborate while working on interdisciplinary project design teams (Schaffer et al, 2012) and how their ability to collaborate affects project outcomes. Scott Schaffer, in *Self-Efficacy for Cross-Disciplinary Learning in Project-based Teams*, explains the importance of understanding “if and how students learn to collaborate while working on multi-disciplinary project design teams.” Because collaboration depends upon access to shared information, computational methods could play a role in a best practice for collaborative interdisciplinary design studio pedagogy.

Central to this approach is effective communication. The current building design process is fragmented and often leads to ineffective design and construction processes (Iordanova et al, 2010). This fragmentation is driven by three factors: the number of disciplines involved with the projects, the overall timing and length of the project, and the length of time between project phases. It is theorized that project fragmentation leads to ineffective design and construction; however, interdisciplinary exchange with a common digital model could provide a coherent environment for these exchanges and enable a non-verbal or graphic team vocabulary for information sharing. The advantages of this model would lead to the assimilation of multiple points of view, generative ideation that could lead to effective learning, an increased opportunity for a wider array of design possibilities, and an effective immersion into an enhanced workflow. Michael Speaks, Dean of the School of Architecture at Syracuse University, states in his Afterword of the University of Kentucky s•ky blue solarhouse publication:

> Among the most significant products that resulted from the design, fabrication, and transport of such an extraordinarily elegant, complex, and ultimately functional house, was the creation of new body of knowledge and new area of expertise. Success required that we develop new ways of formulating and solving problems and thus new ways of working with others. In the case of the s•ky blue solar house, working across common platforms and on hybrid, interdisciplinary teams, yielded solutions that have been impossible to achieve working within the framework of a single discipline or field of expertise (Speaks, 2010).

The s•ky blue collaborative also facilitated the integration of half-scale and full-scale prototypes that enabled the UKY team to quickly "think through and solve problems becoming an integral part of the s•ky blue design process" (Luhan, 2010). In addition to prototyping, technological tools that foster a collaborative, integrative, and streamlined workflow are useful for team projects. Using a shared technological platform such as a Building Information Model would allow a team to simulate building performance and constructability, supply chain integration (Taylor & Bernstein, 2009), and dynamically link to digital fabrication whereby enabling full-scale mock-ups, construction, and collaboration similar to design firms in the profession.

II.3.3 Project Type

For this research, project type is defined as the content and method of project investigation (Lueth, 2008) and addresses the degree of realism of projects in the context of a design studio. Project type ranges from a hypothetically structured academic project to an actual structured engagement inside or outside of the academy.

Project-based learning widely follows a collaborative team-based model of curriculum. By working across scales and at full-scale, these studios foster a type of learning that could increase self-efficacy and facilitate high-impact and student-centered learning. As Keith and Marie Zawistowski note "project-based pedagogy accentuates the range of proficiencies required to produce mature Architecture" (Zawistowski & Zawistowski, 2014). Engagement-based projects vary from design-build to community outreach that differ in intensity and complexity and incorporate design constraints that necessitate feedback from multiple vantage points. These types of projects represent a pedagogical shift from faculty-centered learning models to courses that are student-centered. Effective communication and knowledge transfer between the faculty and the student moves beyond design skill development to include an intentional and carefully considered engagement with the community to ensure that the philosophical underpinnings of the curriculum are maintained. Cross suggests that in the studio context, faculty must "deliberately design" pedagogy to enhance and develop a student's “intrinsic cognitive processes and abilities” and align it with a student’s motivations (Cross, 1982). Cross further suggests that rigorous approaches to “real-world problem solving” could lead to synthesis of knowledge, enhanced skill development, and well-formed design decisions, that are inclusive and reflective of the work produced (Cross, 1982). Cross refers to this reflection as being “self-aware” (Cross, 1982). It also demonstrates a student’s willingness to move beyond surface learning to participate in deeper learning activities (Schaffer et al, 2012) that could enable the student to bridge between the academy and the profession. Both self-awareness and deeper-learning align with the Constructivist Theory referred to by Michael Polanyi as “tacit knowing.” Tacit knowledge is activated through observation, imitation, and practice. The design studio provides an educational framework that enables students to explore hypothetical, abstract, and real projects through project-based learning (PBL) methods that increase in complexity as the students mature through the program. This increase in complexity aligns with Dewey’s assertion in *Democracy and Education* that faculty “connect subject matter to the cognitive development of the students” (Dewey, 1916). Hypothetical design solutions typically follow a formal process beginning problem definition, design research and testing, iteration and prototyping, evaluation, and project development. Hypothetical projects usually stop at the drawn or modeled degree of realization (Cuff, 1991). However, as project type changes from hypothetical to real, so does the level of detail and materiality. The shift from hypothetical to real projects is structured as engagement outside of the academy. These types of problems need to be framed differently (Schön, 1987) and have relevance to the context in which they are situated.

This curricular shift is reflected in courses taught at schools that integrate experiential learning opportunities through design build and community collaboration. These types of projects enable mission-driven programs to reposition and realign both the education and the practice of architecture by realizing designs at full-scale that impact the communities they serve and the students that participate in their realization. These projects also, increase the opportunities for collaboration amongst students and across disciplines. As David Hinson, Department Head at Auburn University elaborated:

> The ultimate goal of producing and implementing an actual response to a real world problem as opposed to a sort of hypothetical response to a problem, is for the student to understand that the real solution has an inherent multi-domain imperative where the architecture student cannot solve the problem exclusively within the domain of the discipline of architecture. The students have to engage these other domains, like structural engineering, construction, and material production. The students have to see a project emerge from paper to become a reality and in doing so challenges them with real and powerful learning outcomes. It also is where the design process as a research enterprise has the most validity because it's forced to push against the rigors of reality (Personal Communication, 17 February 2015).

The pedagogical connection to reality and context are critical components of the hands-on experience. The community-engaged projects such as the Rural Studio at Auburn University are strategically tied to Alabama’s rural context. “The Rural Studio explicitly challenges the paradigms of traditional architectural education. It champions collaboration, communication, and process over product. It exposes students to a range of issues that they are sheltered from in normative architectural education. It is likely that the work of Rural Studio will be held up as an exemplar of how to respond to a world of diminishing resources and increasing poverty gaps" (Moos & Trechsel, 2003). The Design/Build Lab at Virginia Tech, co-founded and co-directed by Keith and Marie Zawistowski has been working to address real world problems by providing architecture to communities of people in southwest Virginia who don't generally have access to the services of an architect. Enabling this connection has three positive impacts: 1) it links the educational process back to the vocational roots of architecture, 2) it positively impacts the community, and 3) it positively impacts the student. Marie Zawistowski stated, "As faculty, we have to be very self conscious, because you're helping the students be who they are and develop whatever it is that they want to do in the world. Students share these experiences with the community and demonstrate to them the value of architecture and the powerful potential of involving architects in their settings" (Personal Communication, 06 May 2015). Through building, the students develop the "competence and confidence to advance exponentially by building themselves what they have conceived in abstraction" (Zawistowski & Zawistowski, 2014). As further elaborated by Keith Zawistowski, the point of design/build education is for the students to "experience the entirety of the process of making architecture in their education. We are not teaching them to be builders. We are teaching them to be architects. They have to figure out how to build their designs into a work of architecture without losing the poetry of the initial intent. We often comment, that they'll never draw the same way ever again after having gone through this experience" (Personal Communication, 06 May 2015). In addition to crafting the learning experience for the students, the faculty serves as a filter to screen the process and the project for the students, so that the undertakings, in terms of scale and technical complexity, can be realized during the academic calendar year. "Students don't know, what they don't know. They have never built before. So we feel that it is our responsibility to help the student to anticipate what to expect" (Personal Communication, 06 May 2015).

These community-engaged projects have similar complexity of decision-making that students face while developing entries to the Solar Decathlon. The Solar Decathlon events are sponsored by the U.S. Department of Energy. The Solar Decathlon started in 2002 and since 2005 has been held biannually. The overall goal of the Solar Decathlon is to challenge "collegiate teams to design, build, and operate solar-powered houses that are cost-effective, energy-efficient, and attractive" (solardecathlon.gov). The purpose of the Decathlon is threefold: first, to educate students and the general public of the energy savings and performative capabilities of design solutions and building products, second, to demonstrate the affordability of energy-efficient construction and renewable resources, and third, to provide students with unique hands-on learning experiences (solardecathlon.gov). This integration requires both an individual and a collaborative studio context. The planning and logistics required for the competition quickly moves beyond the planning of a zero-energy house to include construction, research, full-scale prototyping, simulating, testing, transportation, and training. As a result of this integrated process and product, a tremendous integration of design and engineering emerges out of necessity to effectively compete as a cohesive team (Zaretsky, 2010).

This is especially true in the residential and small-scale commercial structures constructed at the University of Kansas, Studio 804 where “the result of unique combinations of factors—of team dynamics, of student experience, of location, and of mission of the lending agency” (University of Kansas, 2004). In these types of studios, the typical language of “talking and drawing” designing (Schön, 1987) where faculty-student dialogues shifts to a “talking and making” methodology where faculty-student dialogues are enabled through construction and fabrication.

II.4 Project Score

Assessing achievement by an architecture student is typically done through a public presentation. The iterative process of the design studio investigation often results in an end product that has been vetted both inside and outside of the studio environment. As stated in the University of Kansas (KU) Studio Culture Vision and Policy (Appendix 01), design studio reviews, either informally through desk-crits or in-house pin-ups, or more formally through design review, are essential moments that facilitate a thoughtful and respectful, open-minded debate and discussion. “Juries are open environments where the studio practice is exposed to external factors” (Acar, 2015). These reviews enable students to present their projects as evidence of their idea, development of the intended and unintended consequences of the decision-making process, receive critical commentary from an external audience about their projects, and advance their work.

Traditional academic learning processes include knowing, doing, and reflecting (Lenz, Wells, & Kingston, 2015). These operations parallel the topics comprehension, retention, and application. How students perceive their own capability to address problems with recently acquired knowledge is described as the perception about one's own "agentive capabilities" (Bandura, 1997). Education literature defines student learning outcomes (SLO) as "statements of knowledge, skills and abilities that individual students should possess and can demonstrate upon completion of a learning experience" (Proitz, 2010). Learning outcomes appear to share four common attributes: specific and well-defined (to be demonstrated); realistic (to be attainable); active and observable (to be measurable); and outcome-based (to enable performative assessment). The range of learning outcomes align with the learning domains of remembering, understanding, applying, analyzing, evaluating, and creating as articulated by Bloom's Taxonomy (Bloom, 1956).

The 2014 NAAB Conditions for Accreditation "define the standards that professional degree programs in architecture are expected to meet in order to ensure that students are prepared to move to the next steps in their careers, including internship and licensure" (NAAB, 2014). These standards include Student Performance Criteria (SPC). During program review, Departments/Schools of Architecture are required to demonstrate sustained evidence of the SPC across their curriculum. An external peer review team then assesses a program's adherence to those standards, and it is at the discretion of the review team as to whether those criteria are met.

Research demonstrates that this project-based assessment exists at various stages and levels—from holistic design review (which includes the design process and the outcome produced) to design skills to design creativity to design appropriateness to design quality. However, objective assessments are elusive. Schön refers to this type of evaluation as a designer's ability to recognize and appreciate desirable or undesirable design quality (Schön, 1987). This process often requires both verbal and non-verbal means to assess and understand in relation to outcomes. Establishing clearly articulated rubrics to measure project success and then statistically analyzing the rater scores for both inter-rater reliability and intra-rater reliability would bring consistency to assessing the quality of architectural design projects. An example would be the 2012 study at Lawrence Tech where a measurement rubric for judging student project success was developed (Plowright & Cole, 2012). The TIOSE Qualitative Measure is an outcome-based evaluation tool developed to study team interaction, cognitive style, team processes, and the quality of a student design. TIOSE contains five factors for judging architectural design success: Thoroughness, Informativeness, Organization, Synthesis, and Evocativeness.

Literature also supports the equal weighting or valuing of both the process and product of architectural design solutions. The challenge is determining which features and outcomes will be assessed, especially if the reviewer of the work only has the finished artifact to review. Architectural design competition review and selection process may provide some insights into effective measures of artifact-only review (Thompson, 2002). Typically project success is measured by some type of highly respected, external, expert review, similar to how a design competition may be equitably judged for quality against the objectives of the design program and competition requirement. In these cases it is the jury's responsibility to examine and evaluate the design, "regardless of approach" and make a recommendation for selection of entries that merit serious consideration (AIA, 1988). Similar to design studio reviews, the elements of design competition review include juried deliberations and discussion. However the context of the competition review has different intentions. Whereas architectural juries are intended to provoke insightful and informed interaction between the juror and the student around the broader issues of the project assignment and to give feedback to the student that extends student learning to the next iterations of the project, competition reviews find the best solution that fits the competition's objective. Design juries are less about consensus reviews and more about an educational construct that informs learning. Competition deliberations, on the other hand, have been described as an evolving process, where what the jurors are looking for at the beginning of the review, may not be the same as what they are looking for at the end of the review (Van Wezemael, Silberberger, & Paisiou, 2011). There is a need, therefore, to introduce an impartial assessment methodology that enables an objective assessment. This results in an informed decision-making process especially when assessable attributes are articulated clearly. A common ground between the design studio review and the competition review is the shared attributes that reviewers combine their tacit professional disciplinary knowledge with their accumulated personal knowledge (Polanyi, 1966).

II.5 Point of Departure

The literature review is used as a point of departure that links key previous research on self-efficacy, architectural design studio pedagogy, project-based learning, collaboration, and the evaluation of creative work to the research method. The review of literature served as foundation for the dissertation and was also useful in constructing a logical argument that demonstrates how self-efficacy in the design studio could be constructed as a predictive measure of success in design studios. Literature demonstrated that mastery experiences could be used as a dependable and effective measure self-efficacy as mastery experiences relate to belief's in one's personal capabilities while producing task-specific outcomes. In comparison, vicarious, social persuasion, and physiological experiences were identified as influences on self-efficacy, that were shown to have limited and less dependable contribution to the self-assessment of one's own capabilities (Artino, 2012). This review identified that the context and content of learning has influenced self-efficacy in other research and therefore, in keeping with the protocols of constructing those measures, the research should connect the tailoring of predictive comparisons as closely as possible to each individual student (Domer, 1980).

Building from Lueth, this research also categorizes studio type and project type to describe the method and means for developing the requisite skills, knowledge, and expertise to produce architectural solutions at a variety of scales. This was described as way of gauging the influence of the various modes of working in the design studio (individually, both individually and in teams, or in teams) and the types of projects that students address. By understanding these characteristics, it is possible to link the outcomes of the student work to measurable learning outcomes that can be evaluated by using an assessment rubric that result in a project score.

CHAPTER III

METHODS

This chapter presents the formulation of the hypotheses and an overview of the qualitative and quantitative research methods used to test the hypotheses in this dissertation. Each subchapter is separated by the methods used and provides a brief discussion of the research methods, justification of the selected method, the population and sample for the portion of the study, a statement of subject recruitment and privacy protocols, the policy of participant protection, the protocols used for data and safety monitoring and management, the instruments used to collect data and the type of materials collected, and the tools and means identified for data analysis tools, making it possible for others to replicate the study. The results of a pilot study are also presented along with its impact on the final study. This is followed by a discussion of the assumptions, limitations, and delimitations of scope of the research. The chapter concludes with an outline of the intended argument confirming or refuting each hypothesis based on the data to be collected.

III.1 Hypotheses

This research builds upon previous self-efficacy research to better understand the relationships between self-efficacy and collaboration in the architectural design studio. The research is devised to investigate whether the structure of design studios, as defined by studio type and project type, has a measurable impact upon self-efficacy and predisposition to collaborate. It is based on an assumption that improved self-efficacy and increased predisposition to collaborate will be of particular value in contemporary practice and thus affects a student's ultimate success. It is expected that confronting students with messy, real-world problems that differ from carefully formulated hypothetical textbook problems or coursework influences self-efficacy and predisposition to collaborate. These types of problems enable teamwork and collaboration between students from multiple disciplines that raises awareness of the special skills and abilities of individuals in a particular discipline.

This research explored the correlations and causal relationships among Design Self-Efficacy (DSE), Design Self-Efficacy-Mastery (DSE-M), Studio Type (ST), Project Type (PT), Predisposition for Collaboration (PD), Project Score (PS), and Demographics, within the context of NAAB SPC and the norms of architectural education. Hypotheses are formulated and tested using qualitative or quantitative methodology.

III.1.1 Hypothesis 01 Student Performance Criteria (SPC) Can Be Mapped to Self-Efficacy (SE)

The four educational realms of NAAB: Critical Thinking and Representation; Building Practices, Technical Skills, and Knowledge; Integrated Architectural Solutions; and Professional Practice (2014 NAAB Conditions for Accreditation; www.naab.org) have well-articulated learning outcomes. These outcomes are expressed as the Student Performance Criteria (NAAB, 2014) and can be mapped to Design Self-Efficacy (DSE) task-specific questions (Figure III.1a-Figure III.1d).

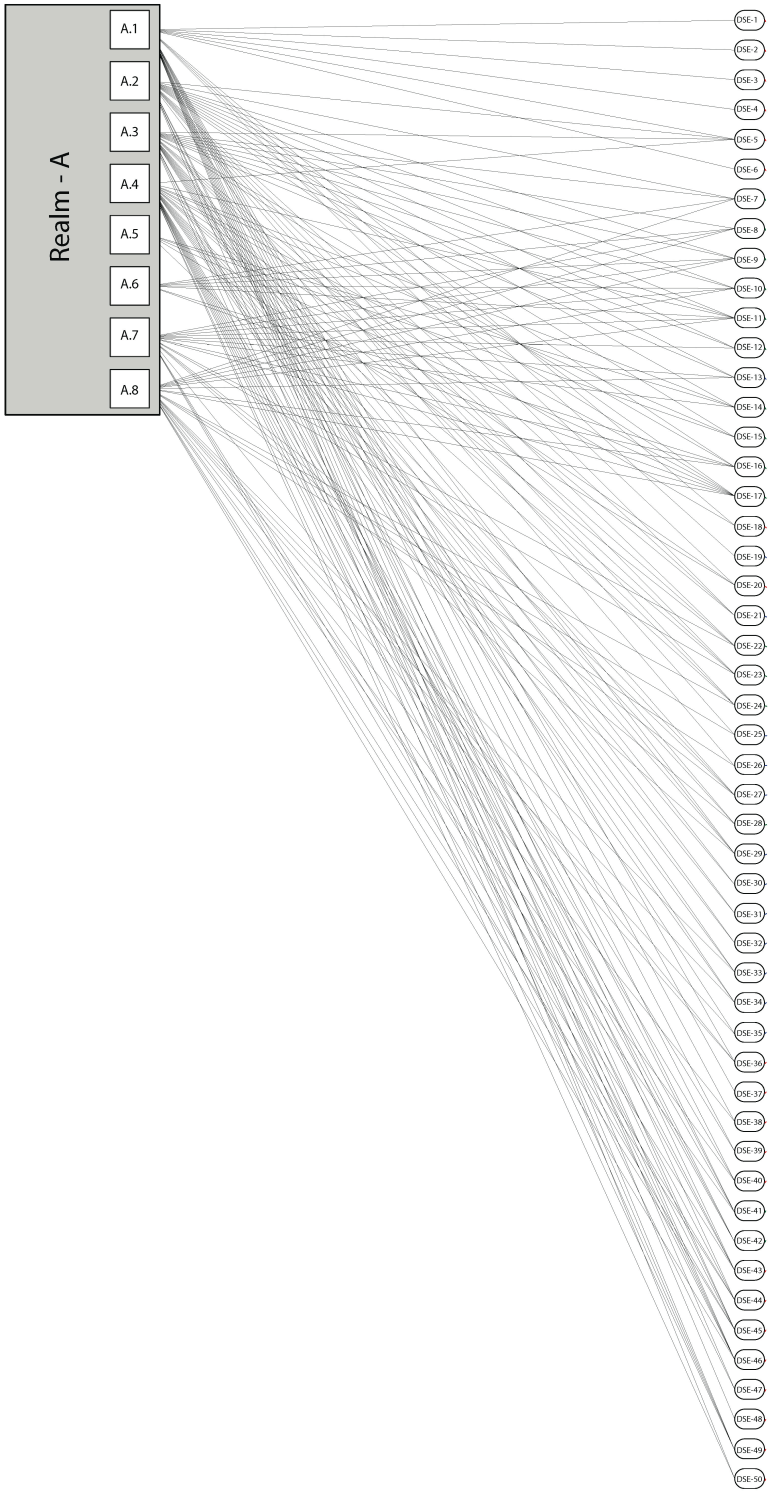

Figure III.1a: NAAB SPC Realm A Linked to DSE Task Specific Items

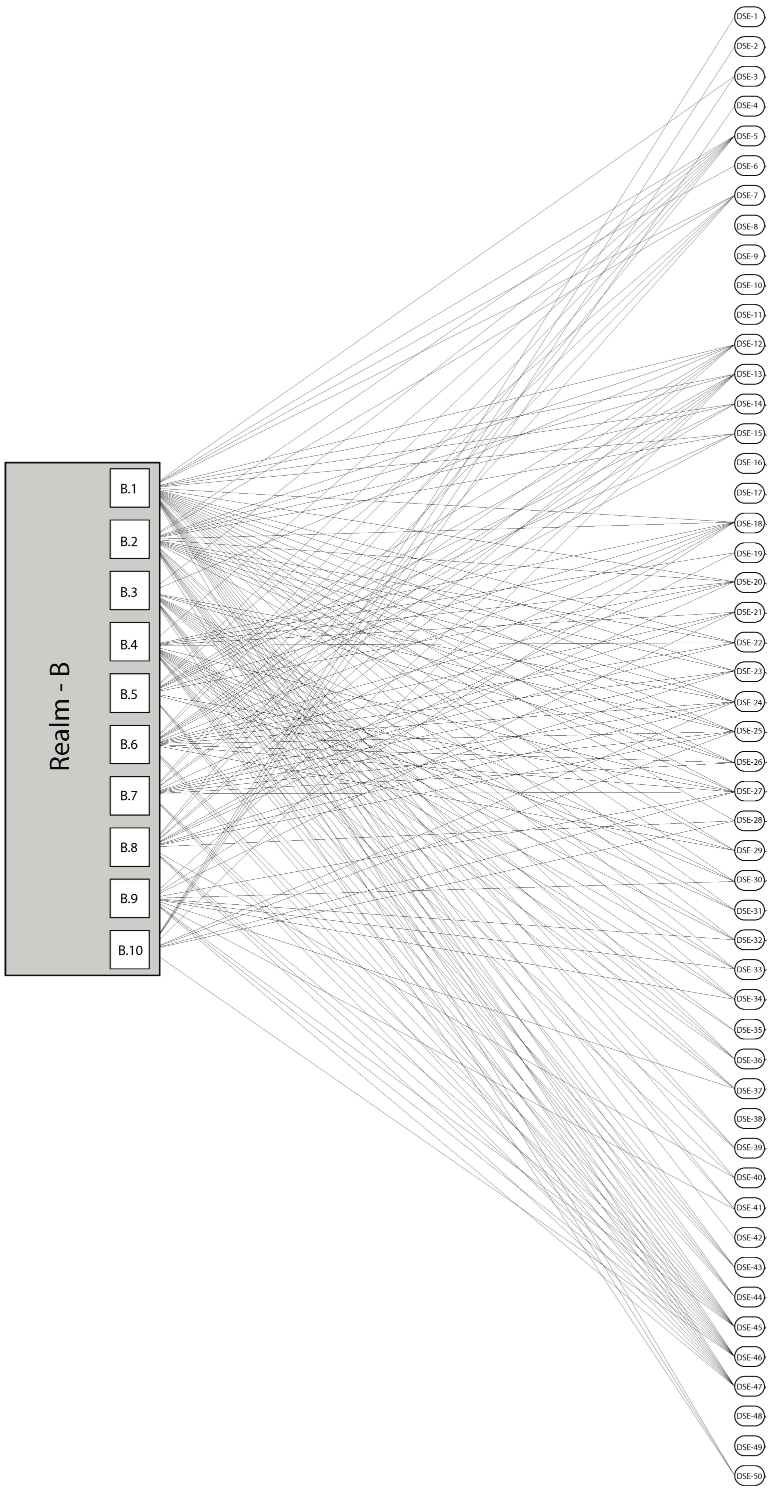

Figure III.1b: NAAB SPC Realm B Linked to DSE Task Specific Items

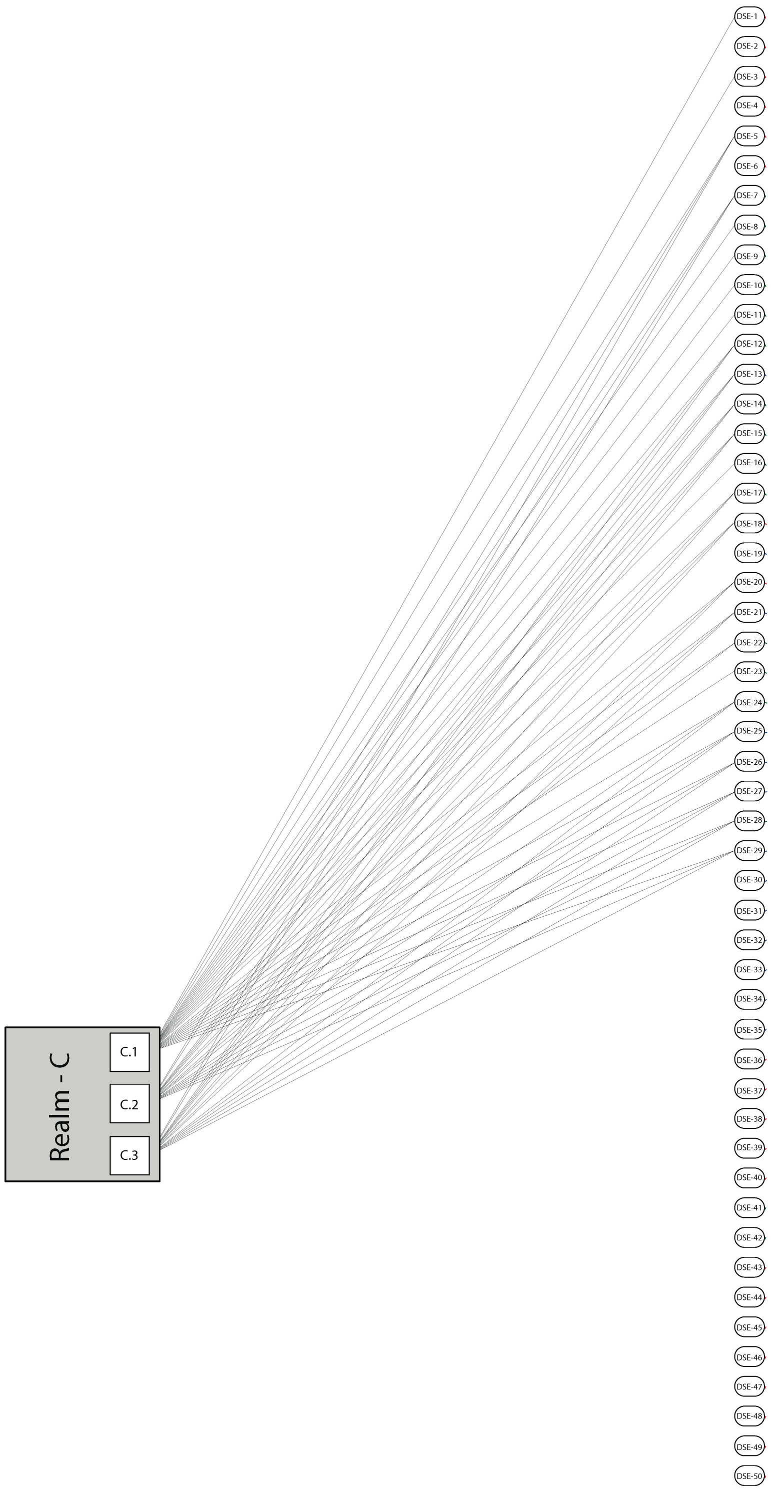

Figure III.1c: NAAB SPC Realm C Linked to DSE Task Specific Items

Figure III.1d: NAAB SPC Realm D Linked to DSE Task Specific Items

This hypothesis will be confirmed or rejected through a coding of content collected from focus groups and interviews with faculty.

III.1.2 Hypothesis 02 Self-Efficacy Can Be Measured in Architectural Design Studios

Measuring Design Self-Efficacy is the center of this research (Figure III.2). It is important, therefore, to use instruments consistent with Bandura's (2006) guidelines to assess self-efficacy. A measurement instrument produced at Tufts University and Purdue University (Carberry, Lee, & Ohland, 2010) to measure self-efficacy in engineering disciplines was adapted to form a measurement instrument of Design Self-Efficacy Mastery experiences of students in an architectural design studio context.

This hypothesis will be confirmed or rejected through focus groups and interviews with faculty and a quantitative statistical analysis of survey result to demonstrate a reliability and validity of the instrument.

Figure III.2: Black Box Diagram Hypothesis 02.

III.1.3 Hypothesis 03 Studios Can Be Categorized into Types (ST).

To understand how different courses can affect self-efficacy, it is necessary to associate courses into various types (Figure III.3). The hypothesis that Studio Type (ST) can be categorized will be confirmed or rejected using qualitative methods of a comprehensive syllabus analysis, a coding of interviews with faculty who teach the studio courses and a review of literature.

Figure III.3: Black Box Diagram Hypothesis 03.

III.1.4 Hypothesis 04 Projects Can Be Categorized into Types (PT).

The type of project that students undertake in a design studio may affect self-efficacy (Figure III.4). The hypothesis, that Project Type (PT) can be categorized, will be confirmed or rejected through a comprehensive syllabus analysis, a coding of focus groups and ethnographic interviews with faculty who teach the studio courses and a review of literature.

Figure III.4: Black Box Diagram Hypothesis 04.

III.1.5 Hypothesis 05 Change in Self-Efficacy is Influenced by Project Type (PT) and Studio Type (ST).

Having established ways to categorize studio type and project type and to measure self-efficacy, it should be possible to determine whether there is a correlation in self-efficacy change over the course of a semester due to studio type and project type (Figure III.5). A design self-efficacy survey instrument was used to collect DSE measures at the beginning and at the end of the semester. The student responses at these two time points was subtracted from each other to demonstrate change in DSE over the course of the semester. This change was used as the dependent variable and ST and PT were used as the independent variables to see the influence of ST and PT on DSE.

Figure III.5: Black Box Diagram Hypothesis 05.

III.1.6 Hypothesis 06 Change in Predisposition for Collaboration (PD) is Correlated to Design Self-Efficacy (DSE), Project Type (PT), and Studio Type (ST).

A collaborative dispositions measurement survey was integrated into the research survey instrument to determine whether PD influences a student's choice of design studio type, whether PD effects a students ability to collaborate, whether PD is influenced by Design Self-Efficacy, and whether PD is a predictor of Design Self-

Efficacy. Students who consented to participate in this research project also participated in self-assessment survey. Upon completion of the 16-item instrument, students received a value estimate with two scores: individualism and collectivism. These scores ranged between 8 and 40 points. Higher scores indicate higher levels of "cross-cultural value" (Singelis, Triandis, Bhawuk, & Gelfand, 1995). Students completed this process at the beginning and at the end of the semester.

III.1.7 Hypothesis 07 Design Studio Project Score (PS) Can Be Measured Objectively.

This dissertation uses the assumption that Grade Point Average (GPA) is not an effective or rigorous measure of student success in architectural design studios. In collaboration with assessment experts, a rubric using a 1 to 4 interval measure was developed and tested to objectively determine design studio project score. Student success will therefore be demonstrated through student learning outcomes and assessed by a well-developed project rubric in design studio contexts where students work through project-based inquiry (Figure III.6).

This hypothesis will be confirmed or rejected through both qualitative and quantitative methods in two ways: first, through qualitative data collection, faculty focus groups, and coding of ethnographic interviews with faculty who teach the studio courses will confirm the criteria of the rubric, and second, by using a statistical method of analysis that includes linear regression with interaction. Inter-rater and intra-rater reliability measures are also used to test the validity of the instrument and the process.

Figure III.6: Black Box Diagram Hypothesis 07.

III.1.8 Hypothesis 08 Design Self-Efficacy (DSE) is Predictive of Project Score (PS).

Data collected in two Design Self-Efficacy surveys will be used to search for correlation between DSE and PS (Figure III.7). This hypothesis will be confirmed or rejected through a quantitative statistical analysis. The Statistical Method of Analysis will include a t-test and/or ANOVA.

Figure III.7: Black Box Diagram Hypothesis 08.

III.1.9 Hypothesis 09 There is Correlation Between Demographics and Self–Efficacy (SE).

Demographic information pertaining to education classification, gender, age, Pell Grant-eligibility, and race/ethnicity was collected from students who participated in the study. As is often found in examination of teaching methods and outcomes, it would not be surprising to find variation in DSE correlated to demographic characteristics.

III.2 Comparison and Selection of Research Methods

The research strategies outlined by Linda Groat and David Wang in *Architectural Research Methods* include experimental and quasi-experimental, correlational, qualitative, historical, simulation, logical argumentation, case studies and combined strategies. These methods enable discovery through measurable controls and empirical research that attribute causality, observations and measurement in a natural setting, social and cultural interaction, archival materials, and philosophical framing (Wang &, Groat, 2013).

Selecting a research method that facilitates inquiry is fundamental to any research. Since design education involves both implicit and explicit knowledge transfer such as the development of graphic and verbal skills and a comprehensive understanding of problem-seeking and problem-solving skills, research that lends itself to a reliance on multiple sources of qualitative and quantitative evidence is necessary. Given the variations of studio approaches to design pedagogy, interpretive historical approaches and logical argumentation for this study were determined to lack reliability. Similarly, given the constraints of the variety of design studios, the scales of projects undertaken, and the levels of complexity for each studio and the variations on teaching, an experimental approach would be very difficult to control and would have required faculty cooperation in allowing a pedagogical intervention in their studio. In addition, a purely observational study of students in the design studio environment, while providing high ecological validity, would have been difficult for replication as faculty, students, setting, and project selection would have prevented the study from being done in exactly the same manner.

Qualitative research methods were used to explore the theory (Marcus, 1998) of collaboration and to facilitate a deeper understanding of the inherent complexities of the studio setting. Quantitative research methods were used to provide insights into the collected empirical data using statistical analysis.

A two-stage research design, theory-led (qualitative studies) and data-led (quantitative studies), was used to gain a more thorough understanding of the methods for measuring Design Self-Efficacy (DSE) and Project Score (PS) to determine student success. The theory-led phase centered on interviews of administrators, interviews and focus groups with design studio faculty, content analysis of design studio syllabi, and careful analysis of NAAB SPC. The theory-led phase produced categories for PT (PT1-Site, PT2-Program, PT3-Client, PT4-Community Engagement, and PT5-Project Realization), categories for ST, survey questions for measuring DSE, and a rubric for PS. The data-led phase used surveys to uncover the possible correlations and causal effects that self-efficacy could have in design education by determining correlations between change in self-efficacy over the course of a semester and predispositions for collaboration, student learning outcomes, and project scores. The combination of interviews, focus groups, content analysis, and surveys produces a rich set of data to analyze. The collected data is used to test the following hypotheses groupings: self-efficacy, collaborative disposition, studio type, project type, and project score.

Different design studio courses at architecture programs at three different universities were studied to reveal varying treatments with respect to studio type and project type. Examination of course syllabi, and interviews and focus groups with instructors enabled categorization of studios and projects into various types. Surveys of students were used to determine the state of student Design Self-Efficacy at the beginning and end of the course. A sample of students enrolled in the studios provided artifacts from their design studio courses. A rubric for assessing design studio project products was employed to determine the success of the students. The data compiled throughout the semester was analyzed and then composed into evidence to support arguments regarding correlations among self-efficacy, collaborative disposition, studio type, project type, and project score. Further analyses were aligned with student demographics.

The mixed-methods research tasks include:

1. Submitting the requisite IRB applications to conduct a pilot study
2. Designing a reliable and validated self-efficacy instrument that aligns NAAB SPC to address the studio context, regardless of studio and project type
3. Testing to determine whether and to what extent self-efficacy is an effective heuristic for measuring student success
4. Conducting a psychometric study of the proposed instrument
5. Conducting focus groups and interviews with design studio faculty

6. Developing and applying a rubric with measureable student learning outcomes, objectives, and assessment
7. Analyzing the research data from all data sources
8. Formulating preliminary conclusions
9. Refining the self-efficacy measurement instrument to align with the design studio context
10. Submitting the requisite IRB applications to conduct the final study
11. Conducting another study using refined instruments
12. Analyzing the research data
13. Formulating final conclusions

III.3 Qualitative Methods

Four sources of data were analyzed for the qualitative portion of this research project: publicly accessible syllabi, focus groups and in-depth interviews with faculty members teaching design studios at TAMU, UKY, and KU, and review of digital versions of student studio artifacts produced during the spring 2016 semester. The qualitative approaches evolved from a grounded theory framework that allowed a range of data to be viewed from multiple vantage points as relates to self-efficacy, design education, studio types, and project types. This method of inquiry aligns with Egon G. Guba and Yvonna S. Lincoln's use of qualitative means to collect and analyze data from which theories could be constructed (Hesse-Biber & Leavy, 2004). Each of the four sources of data is discussed separately.

The sampling method used for the focus groups and interviews consisted of inviting faculty who teach design studios to participate. This method is appropriate for the qualitative portion of the research as it ensures that the faculty participants will have the required knowledge to provide insights to the topics of architectural design studio pedagogy and studio and project categorization. The participants represent different backgrounds and generations of scholarship. The faculty qualifications ranged widely. The differences in professional practice experience, licensure, teaching duration, architecture degrees attained, and ranks of professorship ensured many different styles of pedagogical methods were represented.

Study participants did not receive reward, remuneration, or any direct benefit. Their participation could benefit future design studio instruction, and instruction in other disciplines, to the extent that this study can help improves design education.

Throughout the process, the research maintained objectivity by following a structured focus group protocol (Appendix 03) and a structured interview protocol (Appendix 04), but allowed the conversation to naturally develop and unfold over the course of the discussion.

III.3.1 Syllabus Content Analysis

At the beginning of the semester the sample of publicly available design studio syllabi was collected for studio courses taught at A&M, UKY, and KU.

A number of books and articles that detail the review of syllabi and how to describe the information gathered in this process were useful in analyzing this data. The most effective of these materials included Stanny, Gonzalez, and McGowan who discussed the various types of data that might be generated from a comprehensive review of syllabi including student learning outcomes, descriptions of learning activities, and the methods of assessment (Stanny, Gonzalez, & McGowan, 2015). This approach was coordinated to literature obtained from the Association of American Colleges and Universities (AAC&U) and to personal conversations with Tara Rose and Brandon Combs at the University of Kentucky Office of Institutional Effectiveness and the Office of Assessment. Together, these sources provided detailed and comprehensive information related to the AAC&U rubrics, methods for developing an assessment rubric, and for analyzing and interpreting this information.

These approaches further articulate the higher levels of learning (Bloom, 1956) and the high-impact educational practices that are advocated by the Association of American Colleges and Universities (https://www.aacu.org/resources/high-impact-practices). High-impact learning is an alignment between learner-centered activities and university/institutional priorities that meaningfully contributes to cumulative learning experiences (Kilgo et al, 2015). This type of educational model enables the students to translate knowledge gained in one context and apply it to problems outside of the original context. Research demonstrates that "First-Year Experiences, Common Intellectual Experiences, Learning Communities, Writing-Intensive Courses, Collaborative Assignments and Projects, Undergraduate Research, Diversity/Global Learning, Service Learning, Community-Based Learning, Internships, Capstone Courses and Projects" result in deeper learning, student engagement, and academic retention (AAC&U, 2016).

III.3.1.1 Justification

Completing the content analysis of syllabi enabled the researcher:

- to better understand the types of materials that were distributed to students at the beginning of the semester,
- to identify the common materials, themes, and information,
- to determine the language used to frame the methods of working in the studio—individually or in teams,
- to achieve a better understanding of how the problems were situated—hypothetical or real,
- to determine critical intersections or tangents in design thinking at each of the centers, and
- to examine the parallels between student learning outcomes (SLO) and NAAB accreditation student performance criteria (SPC) (NAAB, 2014).

III.3.1.2 Population and Sample

The sample included all of the syllabi for design studio courses offered in the spring 2016 semester at TAMU, UKY, and KU. These are publicly available by law.

III.3.1.3 Qualitative Data Analysis Tools

The public documents were analyzed using *Atlas.ti,* content analysis software. The research followed the coding procedures outlined by Saldaña (Saldaña, 2009). Using the syllabi as raw data, coding proceeded in four phases: an initial coding (to discover common themes based upon first impressions of the materials), a process coding (that identified action oriented items related to tasks to be performed by the student), an organizational coding (that developed explicit categorization of coded data and then refined the coded data using sub-categorization), and a thematic coding (that brought meaning to the content analysis) (Saldaña, 2009). Content analysis of the syllabi produced data to support interpretation. This interpretation defined the educational methods and articulated common studio themes related to categorization of studio type, project type, and student learning objectives.

III.3.1.4 Procedure

With permission from the Department Head/Director/Chair of each program, the offices of student services at each institution were contacted. During this contact, architectural design studio syllabi were requested for studios that were being offered in the spring 2016 semester. These materials were conveyed through email and saved to both a password protected local computer and a secure hard drive server.

A content analysis of the syllabi was conducted to produce data and evidence that define the educational methods employed. A syllabus review rubric outlined by Stanny (Stanny, Gonzalez, & McGowan, 2015) was used to outline the required components and best practice components. A supplemental measure that identified learner-centered approaches (O'Brien, Millis, Cohen, 2008) for active and engaged learning strategies that promote student success was also included. The items that were identified as being the required components, best practice components, or learner-centered components are provided (Appendix 05). The identifiers used for the initial assessment were coded as: present, partially-present, or absent.

An additional rubric developed for this research project using Brookhart's approach for formative assessment (Brookhart, 2013) was used to better understand the proposed learning targets in design studio curriculum. This student learning outcomes rubric, comprised of the attributes: specific, realistic, observable, and outcome-based was used to identify learning targets for the studio syllabi. The identifiers used for the initial student learning assessment were coded as: present, partially-present, or absent.

The coding and data analysis revealed student learning objectives, studio and project type, design thinking skills, graphic and written communication skills. The coding of the syllabi adhered to the method outlined by Grauerholz & Gibson for specific university required course materials and identified faculty dependent pedagogical strategies: readings, field trips, guest speakers, and reflection (interpreted for this research as desk crits and design reviews/juries) (Grauerholz & Gibson, 2006).

Atlas.ti was used to explore, analyze, and code documents by connecting various source files together using a hermeneutic editor. The hermeneutic interface was used to organize the core content using principles of interpretation that included: quotations, codes, memos, and networks using color-coding in the *Code Manager* to visualize relationships. This coded data was analyzed in the *Network Editor*.

Five distinct categories of learning objectives emerged from the content analysis of architecture design studio syllabi:

Design:

1. The student raises the appropriate design questions in response to a given design challenge—site, environmental condition, and material parameters and other design constraints included in a project brief

2. The student effectively references and evaluates design precedents that relate to a given project

3. The student establishes and compares evaluative performance criteria and then synthesizes them iteratively, to result in an architectural design solution.

Communication:

4. The student communicates effectively with appropriate written materials that describe the project and design solution.

5. The student conveys information accurately using the appropriate graphic and representational media.

III.3.2 Focus Groups

Focus groups with architectural design studio faculty members at Texas A&M University, the University of Kentucky, and the University of Kansas were conducted to support the categorization of ST and PT and to validate the DSE and PS measurements.

III.3.2.1 Justification

To achieve a measurable level of refinement, the classification of courses by studio type and project type must be reliable and valid. In order to effectively match studio type and project type to the project-scoring rubric and link it to the student self-assessment of the methods used in the studio, a large number of faculty were recruited to participate in the study.

The faculty focus groups provided arguments for validity and provided triangulation to the survey data. The analysis of these materials was used as a means of developing a comprehensive understanding of how collaboration is taught, valued, fostered, enabled, and integrated as well as assess the interdisciplinarity of the courses (Wheeler, 2007).

III.3.2.2 Population and Sample

Faculty were recruited from the architecture departments of TAMU, UKY, and KU. Of the population of forty-two eligible faculty as the population, eighteen participated.

III.3.2.3 Subject Recruitment and Privacy

Working in conjunction with each of the program's administrative assistants, a listing of faculty who teach design studios was developed. This listing included faculty email addresses. Design studio faculty at TAMU, UKY, and KU were recruited to participate in a focus group discussion using a recruitment email (Appendix 06). This email explained the research project, the recruitment procedures of faculty, and identified a time and place for the focus group.

III.3.2.4 Protecting Participants

The faculty each completed a consent form (Appendix 07). The focus group discussions were audio-recorded, transcribed, and reviewed from both communication and architectural perspectives. Participant's names were replaced with a role designation (faculty) and number (coded entry).

III.3.2.5 Data and Safety Monitoring

The audio-recorded .wav and .mp3 files and transcriptions of the focus groups were saved to a secure server.

III.3.2.6 Qualitative Data Analysis Tools

The transcriptions of the focus groups were analyzed using *Atlas.ti,* content analysis software.

III.3.2.7 Procedure

In addition to the initial faculty recruitment, the focus group process involved three steps: 1) data collection (faculty responded to a series of questions related to the context and content of design studies), 2) data sorting (through coding), and 3) theory development and alignment with a review of literature.

In preparation for the focus group, the researcher conducted pilot interviews with administrators and faculty at tier one research institutions who were familiar with the field of inquiry—architecture design pedagogy, assessment, accreditation, and licensure of architects. These interviews supported development of the interview guide. The topical areas for discussion included the context and content of design studios at the institutions, the degree and kind of community involvement, the link between student learning outcomes (SLO) and NAAB designated student performance criteria (SPC), the interactions between students and communities, the role of juried reviewed process, and the perception of the juried exchange in terms of educating the general public.

The faculty participants attended one focus group meeting prior to the end of the semester to discuss studio type and project type categories. A focus group was held at each institution. Focus group discussions were targeted for 120 minutes duration. Each focus group was conducted using the same set of open-ended focus group questions (Appendix 03) that ranged from general to specific that necessitated participant reflection, discussion, and insight.

The data analysis of the focus groups followed the method outlined by Krueger for coding the focus group such as: hunches, emergent themes, alignment of field notes and representative quotes (Krueger & Casey, 2000).

Atlas.ti was used to explore, analyze, and code documents by connecting various source files together using a hermeneutic editor. The hermeneutic interface was used to organize the core content using principles of interpretation that included: quotations, codes, memos, and networks using color-coding in the *Code Manager* to visualize relationships. This coded data was analyzed in the *Network Editor*.

III.3.3 Interviews

Interviews with architectural design studio faculty members at Texas A&M University, the University of Kentucky, and the University of Kansas were conducted to further clarify educational strategies, learning objectives, project types, and studio types.

III.3.3.1 Justification

The faculty interviews developed additional validity and provided supplemental information to data obtained in the faculty focus group and student survey data.

III.3.3.2 Population and Sample

The population consisted of all design studio faculty at the three universities. Of the population of forty-two eligible faculty as the population, eighteen participated. During these interviews, faculty clarified the educational strategies that they employed.

III.3.3.3 Subject Recruitment and Privacy

Design studio faculty at TAMU, UKY, and KU were recruited to participate in an interview using a recruitment email (Appendix 06). The faculty each completed a consent form (Appendix 07).

III.3.3.4 Protecting Participants

There are no known risks to participants in this study. There were no risks or discomforts to the participants beyond those experienced in the course of daily life and coursework. The statements made by each faculty during the focus group and by each participant during the interview were kept confidential. The interview discussions were audio-recorded, transcribed, and reviewed from both communication and architectural perspectives. Participant's names were replaced with a role designation (faculty) and number (coded entry).

III.3.3.5 Data and Safety Monitoring

The audio-recorded .wav and .mp3 files and transcriptions of the interviews were saved to secure server.

III.3.3.6 Qualitative Data Analysis Tools

Along with the public documents and focus groups, the transcriptions of the interviews were analyzed using *Atlas.ti,* content analysis software.

III.3.3.7 Procedure

In addition to faculty focus group discussion, faculty also participated in a 30 to 45-minute post-semester interview to personally assign studio type and project type categories to their respective studios (Appendix 08). The Texas A&M University Department of Architecture and the University of Kansas School of Architecture provided a dedicated and secure room for the interviews to take place. In three instances, the interviews took place in faculty offices. At the University of Kentucky School of Architecture the interviews took place in faculty offices. With the exception of three, each of the interviews was conducted in person. The three interviews conducted over the phone were done so to enable greater faculty participation in the research. The interviews followed a structured interview protocol (Appendix 04) that included eleven questions. These questions were intended to serve as a follow-up to the faculty focus group. However, if faculty could not attend the focus group, the beginning of the interview served as a brief summary of the focus group discussion. This helped to provide the faculty with a context for the interview questions.

The interview questions were developed to further explicate a faculty member's personal design studio pedagogy and understand how it parallels the collective consensus that emerged from the focus group discussion. The open-ended interview questions were also designed to get a better sense of why and how student outcomes develop in the architectural studio context and what role community engagement plays in a student's education. Participants were encouraged to expand upon their personal insights and to discuss them in great detail before the next structured question was posed. If tangential discussions emerged, the train of thought was allowed to be built upon and then terminate naturally.

Atlas.ti was used to explore, analyze, and code documents by connecting various source files together using a hermeneutic editor. The hermeneutic interface was used to organize the core content using principles of interpretation that included: quotations, codes, memos, and networks using color-coding in the *Code Manager* to visualize relationships. This coded data was analyzed in the *Network Editor*.

III.4 Quantitative Methods

Data related to self-efficacy, predispositions, project type, and studio type was collected in post-test survey using Qualtrics.

III.4.1 Student Surveys (Self-Efficacy, Predispositions, Studio Type, and Project Type)

An outcome of the qualitative methods was a Design Self-Efficacy measurement instrument (Appendix 09). This instrument, containing fifty items, was developed to translate the twenty-six 2014 National Architectural Accreditation Board (NAAB) Student Performance Criteria (SPC) into self-reported operational *I can do* statements. The domain-referenced items were developed to conform to Albert Bandura's self-efficacy theoretical structure and measure task-specific abilities that each design student must master in order to obtain a professional degree in architecture. This instrument follows Albert Bandura's guide of constructing self-efficacy (Bandura, 2006) and offers a scale for students to assess the "belief in their capabilities" for a given design task. The rationale for using the NAAB criteria and SPC, is its use as a common standard across all one-hundred twenty three institutions that offer the Doctor of Architecture, Master of

Architecture, and Bachelor of Architecture degrees totaling one-hundred fifty four NAAB accredited professional programs in architecture (http://www.naab.org/architecture_programs/home).

Theoretical Groupings related to the NAAB SPC were used to construct validity connecting task-specific DSE-Mastery (DSE-M) items (Figure III.8). Three theoretical groupings were devised using a review of literature and a framework for design pedagogy, and then applied to the DSE-M measures. The theoretical groupings are: 1) ability to evolve an idea in response to site constraints, program requirements, and structure that result in a meaningful solution, 2) the ability to develop the idea in architectural terms, and 3) the ability to present the idea in drawings or models (Caragonne, 1995). For this study, the research referenced the State of Texas Occupations Code, Title 6: Regulation of Engineering, Architecture, Land Surveying, and Related Practices, Subtitle B, Chapter 1051, Article 1: General Provisions; Board of Architectural Examiners (State of Texas Occupation Code, 2013). This document defines the “proper application” of criteria for creative activity and professional services. For this study, the research has two references: the historical pedagogical framework developed by Bernard Hoesli in the 1950’s at the University of Texas in Austin and the four educational realms of the 2014 National Architecture Accrediting Board – Conditions of Accreditation (NAAB, 2014).

Bernard Hoesli referenced these theoretical groupings as “essential and interrelated abilities” that architectural design students must possess. Hoesli’s pedagogy correlate with the five traditional registers of architectural education, most notably, the ability of an architecture student to speak, write, draw, model, and build (Luhan, 2004).

The NAAB Student Performance Criteria are clustered into four realms, defined as: (A) Critical Thinking and Representation, (B) Building Practices, Technical Skills, and Knowledge, (C) Integrated Architectural Solutions, and (D) Professional Practice (NAAB, 2014). Items for each realm were translated into Design Self-Efficacy measures (DSE) (Appendix 10).

III.4.1.1 Justification

The surveys of students were used to collect self-assessment of learning and attitudes. Students participated in surveys to document their background and attitudes, and to gauge their knowledge and achievement. Since self-efficacy is largely a matter of self-assessment and reflection, the survey was an appropriate method for collecting data about self-efficacy. The survey also was used to collect self-assessment of predisposition to collaborate. The measures from these two instruments were used to establish whether a correlation exists between a student's current predisposition for collaboration and the degree of change in self-efficacy between the beginning and end of a project.

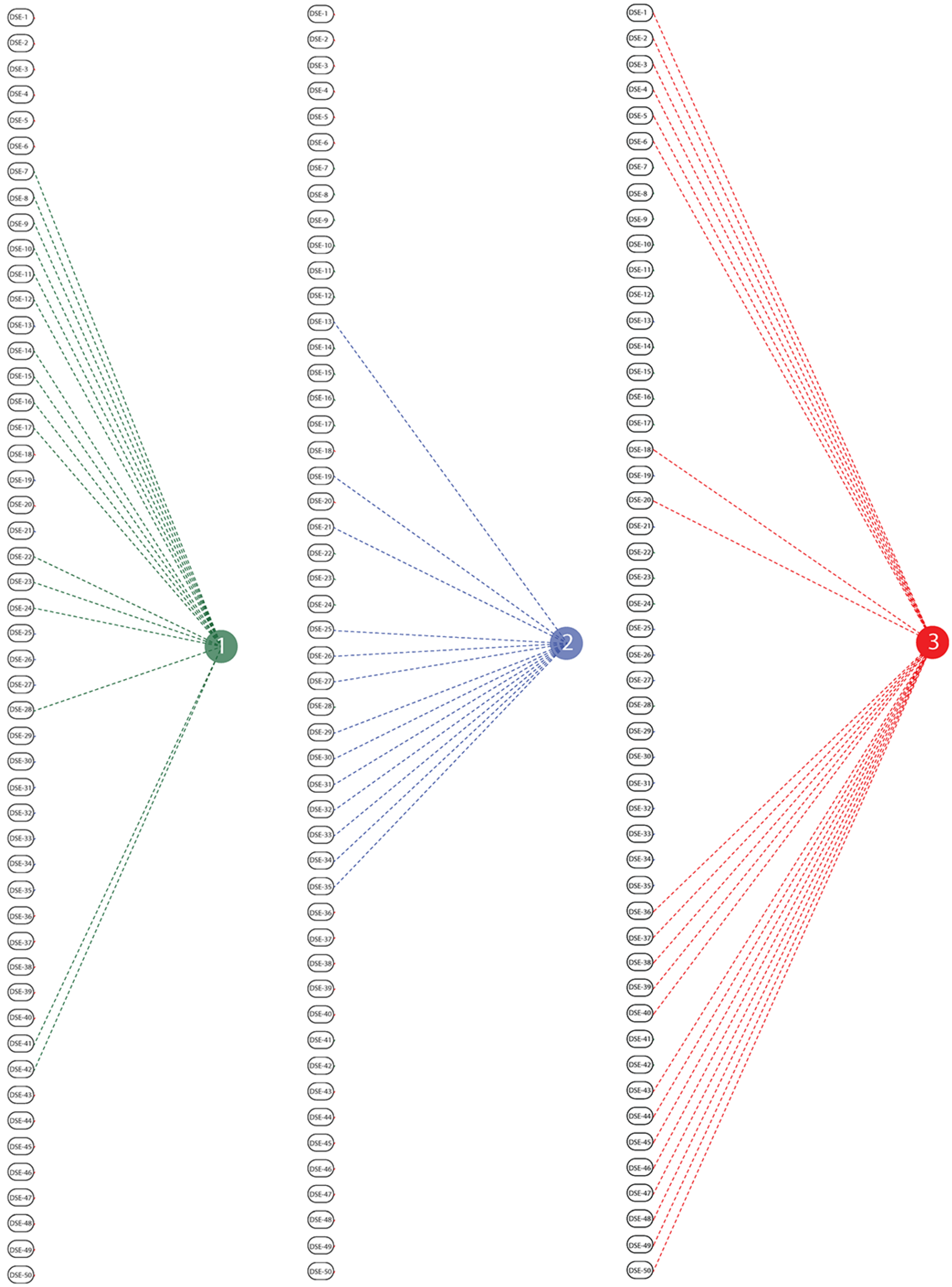

Figure III.8 Theoretical Groupings Linked to Design Self-Efficacy Task Specific Items

III.4.1.2 Population and Sample

The sample was drawn from all lower-division and upper-division undergraduate and graduate architecture courses at TAMU, UKY, and KU. Only students at least 18 years of age were eligible to participate.

III.4.1.3 Subject Recruitment and Privacy

Recruitment methods were dependent upon both the specific portion of the study participants who were recruited to participate as well as the type of data that was sought. Student recruitment consisted of visiting each design studio and presenting the research design. With the instructors' permissions, the research project was presented to the enrolled students and student participation was requested during the initial class periods. The recruitment presentation was followed up with an e-mail distribution from Qualtrics that provided the students with a unique link to the survey. Students were invited to participate in a Web-based survey using Qualtrics. Participating students were each provided with an electronic, online consent form (Appendix 09) as the first window of the Qualtrics survey. Upon consent, they were able to complete the survey (Appendix 09). Their responses were gathered and linked to project score, and demographic data (academic year or level of education, gender, race, ethnic origin, age). Responses were de-identified.

There were no inclusion and exclusion criteria, recruitment methods, or possible issues that could lead to consistent biases in the anticipated sample.

III.4.1.4 Protecting Participants

There are no known risks to participants in this study. There were no risks or discomforts to the participants beyond those experienced in the course of daily life and coursework. Protections were put into place to ensure that neither faculty members nor the investigator knew which students consented to participate in the study. This process was developed specifically to reduce the potential for students to feel pressured to participate.

III.4.1.5 Data and Safety Monitoring

The survey (Appendix 09) was administered to all students who had given an informed consent. The survey provided to students was de-identified by a data broker at the TAMU Office of Institutional Assessment, the UKY Office of Institutional Effectiveness (IE), and the KU Office of Institutional Research & Planning. The roles of the data broker were: email the panel survey, upload the panel data to Qualtrics Online Survey Software and Insight Platform (Qualtrics), link it to institutional data, demographics, and project score data, and assign coding to data. This process ensured that all of the data that was sent to the researcher was anonymized.

III.4.1.6 Materials and Instruments

A survey determined the profile of each student in the sample. The students completed an online consent form followed by a brief 10-minute survey (Appendix 09) that asked students task-wise questions related to Design Self-Efficacy (DSE) and disposition for collaboration (PD).

DSE separates into four parts that align with Bandura's theoretical assumptions that self-efficacy is constructed from four primary experiential sources: mastery experiences, vicarious experiences, social persuasion, and physiological affective states (Bandura, 1997). For this research, DSE-M is related to the task-specific mastery experiences that students face in the studio. These tasks are both challenging and valued by the students and directly align with their previously successful studio experiences. DSE-V are related to the vicarious experiences that students receive in term of the comparative feedback and assessment that students obtain in relation to their student peers; DSE-S are related to the social persuasion that influences a student's capabilities through supportive motivation and constructive criticism that occurs through desk crits and informal reviews; and DSE-P are related to a student's physiological affective states such as stress, anxiety, and fatigue that are often associated with the formal review process and references in the design studio culture policies at NAAB accredited programs. Data related to DSE-V, DSE-S, and DSE-P was collected in the pre-treatment survey and post-treatment survey and were analyzed for the degree of change over the course of the semester. However as noted in the review of literature, in comparison to DSE-M these experiences have been shown to be limited and less dependable contribution to one's own capabilities (Artino, 2012) and therefore not the focus of this research.

Students participated in the online survey (Appendix 09) at two time points over the course of the semester, time point one, at the beginning of the semester and time point two, at or about final review. The second survey also included self-reported questions about studio type and project type.

Bandura states, “if efficacy is to be measured, it must be within a specific context” (Bandura, 1997). As part of a metacognitive study that focused on the impact of collaboration in the context of integrated design studios, the research design aligned the theoretical guidelines of design education to an existing instrument. This reliable and validated self-efficacy measurement instrument was used in studies at Tufts University and Purdue University (Carberry, Lee, & Ohland, 2010). The Carberry, Lee, & Ohland instrument used the standard 100-point scale advocated by Bandura (1997). In order to be a judgment of capability, the Design Self-Efficacy (DSE) instrument is structured using the standard 100-point scale to phrase question items in terms of a student’s *can do* beliefs (Bandura, 1997). The scale ranged from 0 *cannot do* to 50 *moderately certain can do* to 100 *certain can do* (Bandura, 1997) and related specifically to NAAB SPC (Appendix 10).

Further, the research design also integrated a collaborative predispositions measurement survey (Singelis, Triandis, Bhawuk, & Gelfand, 1995). The disposition to collaborate was measured using a well-established instrument and linked to the online survey. The predispositions measurement instrument is publicly available at: (http://highered.mheducation.com/sites/0070876940/student_view0/chapter2/activity_2_6.html). As part of the study surveys, students’ dispositions to collaborate scores were self-reported. Whereas the existing individualism and collectivism survey instrument is typically used to isolate people who have problems collaborating, for the study, this data was used to see if there is a possible correlation between collaborative disposition and self-efficacy.

III.4.1.7 Procedure

The surveys were distributed through Qualtrics and automated reminders set for twice a week (on Mondays and Fridays). The reminders were sent to each student until the student responded to the survey or the survey time frame closed.

III.4.1.8 Quantitative Data Analysis Tools

Previous self-efficacy research has employed a number of analytical methods to investigate the sources of self-efficacy, their causal influence, their multidimensionality, and the contextual factors that may moderate them (Usher, 2007). This dissertation utilizes a scale validation analytic procedure using quantitative analyses such as exploratory factor analysis (EFA), principal components analysis (PCA), and descriptive exploratory analysis (means, standard deviations, and frequency distributions).

The Design Self-Efficacy measurement instrument developed for this research project contains fifty items. The goal of this large number of items was to capture the multidimensionality of self-efficacy in the design context. These elements align with the four realms (A, B, C, and D) of the 2014 National Architectural Accreditation Board (NAAB) Student Performance Criteria (SPC). The realms are defined as: (A) Critical Thinking and Representation, (B) Building Practices, Technical Skills, and Knowledge, (C) Integrated Architectural Solutions, and (D) Professional Practice (Appendix 10).

Whereas the intent of the accreditation process is to distribute these criteria across the entire curriculum, the DSE measure developed for this research focuses specifically on those criteria that align within the context of the design studio. The centers used for the study were Texas A&M University (TAMU), the University of Kentucky (UKY), and the University of Kansas (KU). Since each accredited program has different methods for distributing SPC throughout their program, a content analysis of the studio syllabi was completed. Since self-efficacy requires contextualization within a situation that requires action (Bandura, 1997), SPC were translated into questions that relate to task specific activities.

III.4.2 Project Score

Design and creativity requires the experimentation and synthesis of a variety of variables in order to result in a creative and effective design solution. Comparing and assessing the products of creative design is often elusive. As noted by Lueth (2008), instructors should develop explicit rubrics and assess students on how they accomplish the goals of the studio (Lueth, 2008). The rubric developed for this research is intended to help design studio faculty, professionals, and community stakeholders evaluate and score student work samples (artifacts) resulting from an assigned project. The rubric can be used across architecture design studios to score the attainment of student learning outcomes and enable the assessment of creative designs across a broad range of studio contexts, project types, and scales. The rubric is intended to be neutral to the range of projects in architecture design courses, which may vary from small-scale objects to inhabitable buildings to urban design. An individual student or a group of students may complete these artifacts and unless described in the text, the method of developing the solution (individually or in teams) will not be assessed.

The rubric has two primary categories—design and communication—that emerged from a content analysis of architecture design studio syllabi.

The Design categories and subsets are defined as:

1. Design Research and problem solving: The student raises the appropriate design questions in response to a given design challenge—site, environmental condition, and material parameters and other design constraints included in a project brief
2. Design Iteration, data collection and analysis: The student effectively references and evaluates design precedents that relate to a given project
3. Design Evaluation and integrative learning: The student establishes and compares evaluative performance criteria and then synthesizes them iteratively, to result in an architectural design solution.

The Communication categories and subsets are defined as:

4. Written presentation: The student communicates effectively with appropriate written materials that describe the project and design solution.
5. Graphic / visual presentation: The student conveys information accurately using the appropriate graphic and representational media.

Development of rubrics for assessing project documents are also presented and defended with respect to reliability and validity. As outlined by Moskal and Leydens, the assessment rubric used the three forms of evidence to ensure validity of the instrument: content, construct, and criterion (Moskal & Leydens, 2000). Content evidence focuses on sampling a student's knowledge of a subject or domain (Moskal & Leydens, 2000).

For this research, the assessment of content evidence focuses on scoring criteria specific to design problem setting and problem solving, design research, and written and graphic communication. Construct evidence relates to processes that are internal to an individual and a student's foundational methods of working (Moskal & Leydens, 2000). For this research, the assessment of construct evidence focuses on design iteration and design evaluation as the means to evaluate the designs prior to constructing the artifact for review. Criterion evidence focuses on the application of knowledge and its correlation to the current design and impact on future events (Moskal & Leydens, 2000). For this research, the rubric is designed to follow the design processes thus developing what Rafilson refers to as the transference of validity from one situation to another (Rafilson, 1991).

III.4.2.1 Justification

For the purpose of NAAB accreditation, curricular assessment is aligned with student learning outcomes and evidences of Student Performance Criteria (SPC). According to NAAB, all "SPC are treated as equal forms of evidence of student achievement" (NAAB, 2014). Attainment of an SPC should be apparent in the products that a student produces in response to a design assignment. For this research, an instrument was constructed to allow external evaluators to review, vet, and score the work produced in studio, indicating whether learning outcomes have been attained.

III.4.2.2 Population and Sample

The population for the study was all students enrolled in design studios at TAMU, UKY, and KU above the age of eighteen. The survey participants were self-selected.

III.4.2.3 Subject Recruitment and Privacy

Student recruitment consisted of visiting each design studio and presenting the research design. The recruitment was followed up with an e-mail distribution that provided the students with a unique link to a Qualtrics form that enabled the upload of the student artifacts (Appendix 12). There were no inclusion and exclusion criteria, recruitment methods, or possible issues that could lead to consistent biases in the anticipated sample.

III.4.2.4 Protecting Participants

All project scoring was de-identified by a data broker in the Offices of Institutional Effectiveness (IE) at the respective institutions. The IE data broker coded and linked the student related content for analysis.

III.4.2.5 Data and Safety Monitoring

The call for student projects (Appendix 12) was administered to all students who had given an informed consent to have their information turned over to the researchers as de-identified data. The survey provided to students was de-identified by a data broker at the Office of Institutional Effectiveness (IE). The roles of the data broker were: email the panel survey, upload the panel data to Qualtrics Online Survey Software and Insight Platform (Qualtrics), then link it to institutional data such as demographics and project score, then assign anonymous coding to data. This process ensured that all of the data that is sent to the researcher for analysis was de-identified.

III.4.2.6 Materials and Instruments

A project assessment and scoring rubric (Appendix 13) was initially developed in collaboration with assessment experts at the University of Kentucky to guide reviewers in their assessment of the artifacts.

This rubric was developed using three sources of data: the AAC&U VALUE Rubric, faculty focus groups and interviews with design studio faculty at the Texas A&M University (TAMU), The University of Kentucky (UKY), and the University of Kansas (KU); and the content analysis on architectural design studio syllabi at TAMU, UKY, and KU. This project scoring assessment rubric incorporates all four educational realms of the National Architecture Accrediting Board (NAAB) - Critical Thinking and Representation; Building Practices, Technical Skills, and Knowledge; Integrated Architectural Solutions; and Professional Practice. (Source: 2014 NAAB Conditions for Accreditation; www.naab.org) and the corresponding twenty-six student performance criteria related to those realms.

This rubric is intended to help design studio faculty, professionals, and community stakeholders evaluate and score student work samples (artifacts) that demonstrate evidence of student learning outcomes in architecture design studios. The rubric may also be used as a foundation for the assessment of creative designs across a broad range of studio contexts, project types, and scales where experimentation and synthesis of design constraints result in a creative and effective design solution. Studio projects may vary from small-scale objects to inhabitable buildings to urban design.

This rubric uses a 1 to 4 interval measure with 1 being the lowest value and 4 being the highest value for each of the five categories established by the research. These categories include design research and problem-solving, design iteration and data collection and analysis, design evaluation and integrative learning, written communication, and graphic communication. The intent of the rubric was to assess the student's knowledge in architecture for a given project and their ability to convey that knowledge in a graphic format. The instrument used during data collection of project scoring was the AQUA platform developed by Taskstream.

III.4.2.7 Procedure

At the end of the semester, artifacts were collected via Qualtrics. To ensure de-identification throughout the process, a workflow was developed in conjunction with the data brokers at each of the institutions. The artifacts were bulk uploaded into the AQUA assessment platform, aligned the work to a design evaluation-scoring rubric (Appendix 13), and evaluators randomly assigned to assess and score the artifacts. This evaluation was preceded with two sessions: a training session, and a norming session. The intent of the training session was to familiarize the evaluators with the rubric and the assessment tools. The norming session demonstrated how to identify evidences by using the rubric and assess effectively inter-rater reliability through the norming process. A cadre of external evaluators who were asked to assess the work and use the assessment rubric as a guide to score the work evaluated the final studio projects (Appendix 13). The scores were reported electronically and coded by the data broker to associate them with the individual students who are participating in the study. The data brokers provided the linked data to analyze.

III.4.2.8 Quantitative Data Analysis Tools

Data relative to project scoring was collected and displayed in the Analytics Dashboard as part of the AQUA platform. Rater scores for each artifact were incorporated into this scoring system to increase its validity and studied for inter-rater and intra-rater reliability. The scores from multiple reviewers was averaged and compared to determine the level of inter-rater agreement.

III.5 Pilot Study

Measuring Design Self-Efficacy (DSE) in the context of architectural design studios and understanding the influence of studio type, project type, and student predispositions on those measures is the primary interest of this research. Initial drafts of the instruments were used in a pilot study that was completed in the spring 2015 semester at the University of Kentucky. This process included a test/re-test of survey questions and exit interviews with high-performing students (students who had high design studio grades) and low-performing students (students who had low design studio grades) to ensure that the phrasing of the questions was clear and that the students could understand what was being asked of them.

III.5.1 Spring 2015 Pilot Study

The Spring 2015 semester pilot study (UKY IRB#14-0993-Z4B) (Appendix 14) was a quasi-experimental, split-block research design with multiple measures that demonstrates impact on student self-efficacy and communication. The results of the Spring 2015 pilot study were evaluated during the Summer 2015. Additional IRB applications at TAMU (TAMU IRB#2015-0860D) (Appendix 15) and UKY (UKY IRB#15-0680-P4S) (Appendix 16) were submitted in the Fall 2015 semester. These IRB applications were approved prior to the beginning of the Spring 2016 semester. The University of Kansas did not require an IRB to extend the study to its campus. This survey instrument was fully deployed in the Spring 2016 semester and the data collected for the final study.

The experimental unit for the pilot study was a student-by-project with repeated measures of the students at the beginning and at the end of the semester. To establish a baseline measure of Design Self-Efficacy (DSE) and predisposition for collaboration (PD) a "test in" at the beginning of the semester was given to students prior to the faculty presenting a studio problem. After the final review self-efficacy and predispositions were measured again along with studio type (ST) and project type (PT). By gathering research data in this manner, sample data defined the studio as a way of understanding both ST and PT while gathering DSE and PD measures for the students throughout the semester. At the conclusion of the data collection phases, these differences were statistically analyzed and tested for correlation.

III.5.2 Spring 2015 Preliminary Results

The results of Spring 2015 pilot study entitled: "Interdisciplinary Exchanges in a Design Studio Context: Student Efficacy and Knowledge Transfer" developed in collaboration with Dr. Amy L. H. Gaffney, an Assistant Professor of Instructional

Communication and Research in the School of Information Studies and Mary Ann Nestmann, the Instructional Technology Manager for PresentationU at the University of Kentucky, suggests that there is strong evidence for correlation between student responses to questions related to Design Self-Efficacy and the processes of typical architectural design development and communication. Because the sample size was lower than the number of question items in the instrument, there were limitations in the number of statistical conclusions that could be made.

However, there appeared to be four emergent groupings of questions that strongly correlate (.7 or above in a 35x35 analysis). These groupings separate into four categories: Research, Design, Evaluation, and Communication.

1. Group 1 – Research
    a. DSE_10 - Ability to connect design precedents to the design project,
    b. DSE_16 - Ability to identify relevant precedent for a project,
    c. DSE_20 - Ability to construct models that illustrate and identify all necessary information for a building design,
    d. DSE_13 - Ability to collect relevant information to support conclusions related to a specific project,
    e. DSE_26 - Ability to predict the effectiveness of a design if implemented
2. Group 2 – Design
    a. DSE_24 - Ability to set evaluative criteria for possible designs,

   b. DSE_27 - Ability to make design decisions in complex project whiles considering the variety of influences (e.g. accessibility, environmental systems and structural systems),
   c. DSE_29 - Ability to respond to site specific characteristics in my design
3. Group 3 – Evaluation
   a. DSE_18 - Ability to create technically clear drawings,
   b. DSE_19 - Ability to prepare outline specifications,
   c. DSE_33 - Ability to establish required points of exit,
   d. DSE_34 - Ability to check egress paths for travel distances
4. Group 4 - Communication
   a. DSE_1 - Ability to use effective oral communication that is appropriate for other people within the profession
   b. DSE_2 - Ability to use effective oral communication that is appropriate for the general public
   c. DSE_6 - Ability to use representation media (i.e., models and drawings) that are appropriate for the general public

Early evidence suggests that design self-efficacy question items *DSE_4 - Ability to write effectively for the general public, DSE_14 - Ability to use formal, organizational, and environmental principles to inform my design,* and *DSE_15 - Ability to apply fundamental ordering principles to natural and man-made systems* do not correlate strongly (less than .3 in a 35x35 analysis) with each other.

The emergence of four groupings and categorizations—Research, Design, Evaluation, and Communication—was then compared against the theoretical grouping of three essential skills and abilities developed by Bernard Hoesli at the University of Texas in the 1950s: the evolution of a design, in architectural terms, that responds to design constraints, building program requirements, and structure, that is conveyed in terms of models and drawings (Caragonne, 1995). For this research, these theoretical categories align to NAAB SPC as a consistent framework for analysis of evidence (Appendix 10).

III.5.3 Impact on Final Study

By conducting the pilot study, four topics were introduced into the final study: a confirmation of NAAB SPC mapping of student learning outcomes to task-specific DSE questions, reverse coding of questions, the introduction of a predispositions survey instrument, and the use of a data broker. The constructed DSE measurement instrument was developed in alignment with Bandura's self-efficacy assertion (Bandura, 2006). This instrument used the tasks dictated by the 2014 NAAB SPC as a structure for assessing evidence of understanding and ability of design knowledge for all students enrolled in the accredited programs of architecture. The SPCs are mapped across all design studio levels, regardless of context (studio types) and project types to see if certain criteria are weighted differently.

In the initial self-efficacy survey instrument all of the questions were positively coded and delivered in a continuous question and answer screen. It has been suggested that offering a mix of positive and negative coded questions and by separating the questions into smaller groupings could better focus student's attention. To address this issue, some of the existing questions were reverse coded and reorganized in the Qualtrics survey to enhance usability (Appendix 09).

In order to better understand a student's predisposition for collaboration, an individualism and collectivism instrument was inserted into the DSE instrument so that students could self-report their scores.

Also, in order to develop the comprehensive final data collection and analysis, a trusted data broker from each of the respective University was recruited. These data brokers were charged with emailing the panel survey, assigning anonymous coding to de-identify data, uploading the panel data to Qualtrics, and then linking it to institutional data such as demographics. In doing so, the data brokers enabled the researcher to analyze the data in compliance with the IRB and focus on the results without confounding the study.

III.6 Assumptions

The fundamental assumptions for this dissertation are: self-efficacy is a predictive measure of student success in future academic and professional settings, the pre-treatment and post-treatment surveys accurately measure self-efficacy and collaborative disposition, and the assessment rubric is an acceptable measure of project score and quality. In addition, it is assumed that the instructors for the design studio courses would contribute to the study, teach effectively, and that the students were capable of learning the required material presented in the studio.

III.7 Limitations and Delimitations

III.7.1 Limitations

The limitation of the pilot study conducted in the spring 2015 semester was the modest number of architecture student participants. For the final spring 2016 study, a larger group of students was recruited to participate. The recruitment process involved the cooperation of department chairs and design studio faculty at TAMU, UKY, and KU. Data collection was limited to students who participated in the study through an online survey instrument and distributed through Qualtrics.

An interview with Ellen Usher, a self-efficacy expert at the University of Kentucky College of Education P20 Innovation Lab, revealed that the administration of the survey in paper may increase response rates (Personal Communication, 25 June 2015). However, research on this topic was inconclusive (Hohwü et al, 2013). In addition, this would have necessitated greater involvement of research personnel and greater project expense. It was concluded instead, to invite all students to participate, extend the study beyond TAMU to increase the sample size of the study, and to customize the Qualtrics skin to the participating institution.

The limitations of the study related to the DSE instrument were:

1. Since this was not a controlled experiment, results may have been affected by outside influences.
2. All NAAB Student Performance Criteria were treated as equal forms of evidence of student achievement.

3. The DSE instrument is self-reported and therefore there is risk that a student could over-estimate or under-estimate their capabilities for a given task. However, self-efficacy is essentially a self-measured quality. Thus, self-reporting is the appropriate way to measure it.
4. Items in the instrument were presented in the same order for both the pre-treatment survey and post-treatment survey. In future research it would be useful to conduct a research study that compares items presented in same order to those presented in randomly assigned orders to see if there is difference in the response.
5. The use of the 0-100 scale aligned with Bandura's self-efficacy scale produced meaningful results. In future research, it would be valuable to combine the DSE instrument with item response theory to further hone and refine the instrument.
6. The DSE instrument only received data from the students through pre-treatment survey and post-treatment survey instruments. In future research it would be beneficial to conduct student interviews to discuss the degree of Design Self-Efficacy change over the course of the semester interview students to understand why change occurred.
7. Because the student participants self-reported data, the study was limited to the student's unverified perspectives.
8. In addition, as this research does not track the students beyond one semester to gauge how they are doing professionally, this research cannot claim that

the studio type or project type treatment has long-standing impact beyond the study. However, this research, with its specified time horizon, implicates that one of the extensions of this research program is a longitudinal study that would track students through subsequent academic years into their initial professional years.

9. This research assumes that students have been continuously assessed in the classroom and that a project-scoring rubric is appropriate for assessing each student.
10. Due to the nature of the research, one of the limitations of the project scoring rubric was that the rubric was not shared with the students in advance of the evaluation. Therefore, it was not possible for the student to cater their design representations to specifically address each of the criteria.

In spite of these limitations, every possible effort was made to design the research in a way that maximizes the potential contribution of the study's findings about how self-efficacy is registered in architectural design studios.

III.7.2 Delimitations

The delimitations of the dissertation research design include a focus on both undergraduate and graduate architectural design studios. The results of this study could be generalized to teaching methods in courses that involve design studios of all types, regardless of project types. In further studies, generalizability will focus on integrated design studios that are collaborative, interdisciplinary, and focus on real projects that are too complex to be solved by one discipline or viewed from one vantage point. The research may also have value to fields of design other than architecture.

III.8 Summary of Methods

The research design uses both qualitative and quantitative methods to develop and validate instruments, collect and analyze data, and draw conclusions. A multi-method approach combined qualitative methods with correlational analysis. Qualitative methods were used to develop the instruments for measuring independent variables and dependent variables. Quantitative methods, primarily correlational analysis, collected data using the instruments and then used statistical methods to search for correlations and causality. Effects were examined across a range of design studio types, project types, and approaches to teaching and also studied students in various contexts of design pedagogy. The rationale for this range was twofold. First, the range provided unbiased theory building that emerged from valid qualitative methods applied to a natural sample of design courses and instructors. This was achieved through syllabi content analysis and focus groups and interviews with faculty who teach design studios. Information gathered in these processes tested hypotheses 01, 02, 03, and 04. Second, the range allowed data collection from a wide variety of students in studio settings. Student performance was studied using surveys that established the state of student self-efficacy at the beginning of a semester, treatments with respect to course assignments that are characterized by project type and studio type, measurement of the state of student self-efficacy at finals, and assessment of the products produced by students. Information gathered in these processes tested hypotheses 05, 06, 07, 08, and 09. The observations of the data collected using this mixed-methodology is explained in the next chapter of this dissertation.

CHAPTER IV

DATA AND OBSERVATIONS

This chapter presents the data collected in the final research. The subchapters are separated by the methods used to collect the data and include the descriptive statistics that describe the profile of the participants, the overview of the data, the arguments for reliability and validity of the research design, and the emergent themes that surfaced during their analysis. This chapter concludes with a summary of data and observations that informed the data analysis.

IV.1 Qualitative Methods

In conformance to recommended practices in qualitative research, the data collected through syllabi content analysis, transcribed focus group discussions, and transcribed interviews was initially open coded for research topics in a way that would be useful for preliminary alignment to the interviewer's written notes (Lofland, 2005). Documents from all three sources were analyzed using roughly the same methods of qualitative research. This coding was documented in the text with bracketed characters and icons to capture the perspectives of the interviewees, and prompt further analysis. As defined by Saldaña this type of coding is meant to capture the "salient, summative, and/or evocative attribute" (Saldaña, 2009) that was revealed in the interview process. Following an interview guide for focus groups (Appendix 03) and interviews (Appendix 04) informed by the review of literature and syllabi content analysis, coding led to the identification of four key topic categories or units of meaning. These categories are distinguished by social groupings as Foundations (F)—common responses across centers, Translations (T)—center-specific responses, and Visioning (V)—faculty-specific responses. In addition, coding included a category of Evolutions (E)—transformative opportunities, to form theoretical constructs for the dissertation.

To address concerns of internal bias and objectivity that may undermine the validity and reliability of the qualitative methods used in this research, four verification criteria, advocated by authorities, were incorporated into the research design protocols to ensure research rigor (Morse et al, 2002). These verification strategies coordinate the fitness and alignment of the research questions with the appropriate research methodology, the selection of participants who represent the knowledge of the research topic, the concurrent collection and analysis of research data, and the theoretical coordination of review of literature with perspectives revealed in the data collection process. These verification processes build upon the educational audit endorsed by Lincoln and Guba (Lincoln & Guba, 1982) and both researcher and participant trustworthiness (Lincoln & Guba, 1985) and the utility advocated for by Krefting and Morse (Krefting, 1991)(Morse, 2015). Collectively, these strategies strengthen the internal and external measures of validity, the credibility of the researcher and participants, and the overall rigor of the research and its findings.

The intent of the syllabus review was to produce data and evidence that defined the educational methods employed and to give insights into the categorization of studio type and project type. This content analysis adhered to the methodology outlined in the research design. The materials identified for the review include all of the studios offered at the three universities during the spring semester of 2016. The faculty who are teaching these design studios represent the full range of knowledge of the research topic both within and outside of the academy. The collected materials were examined using the rubrics outlined in Stanny (Stanny, Gonzalez, & McGowan, 2015) and the AAC&U (https:// www.aacu.org/resources/high-impact-practices). The analysis and collection of the research data was completed concurrently and was analyzed by the researcher using best practice perspectives that emerged from the review of literature. This review process could have higher validity if multiple raters had reviewed representative syllabi and measures of inter-rater and intra-rater reliability were introduced.

In addition to the four verification criteria advocated by Morse, Barret, Mayan, Olson, & Spiers to ensure research rigor (Morse et al, 2002), the following arguments are presented to address possible researcher bias and to establish the reliability and validity of the research findings: reflexivity, internal consistency, and member checking. The researcher exercised reflexivity by having a dual role in the research, as a graduate student and as a tenured full professor of architecture. The researcher is a recognized authority in architectural design education with over eighteen years of experience teaching design courses and leading focus groups and conducting oral history interviews. This experience is combined with twenty years of professional experience as a licensed architect. To promote internal consistency of the research, the focus groups at each institution followed the same protocol. The researcher's notes and jottings were immediately compared to the transcriptions and then to data collected from structured interviews, syllabi content analysis, and a review of literature. Following the coding and analysis, member checking was used with a representative sampling of participants from each group to verify the depiction of the data in the report (Krefting, 1990).

IV.1.1 Syllabus Data Observations

Publicly available architectural design studio syllabi were requested from each of the Departments/Schools of Architecture involved in the study. The syllabi were obtained prior to the semester and analyzed. In total, there were fifty-nine syllabi (n=59) collected from the centers (Table IV.1). This number represents 100% of the design studio-related courses offered in the spring 2016 semester at TAMU, UKY, and KU. Some of the courses, while studio-like, were actually complementary courses associated with design studios. Twenty-seven syllabi were collected from TAMU including eight design and communication drawing classes. Sixteen syllabi were collected from UKY including one design and communication drawing class. Sixteen syllabi were collected from KU. The design communication courses were not included in this research analysis. The design studio syllabi ranged from three to thirty pages.

An examination of the TAMU, UKY, and KU program websites revealed two types of curricula: NAAB-accredited (TAMU graduate program, UKY and KU undergraduate and graduate programs) and non-NAAB-accredited (TAMU undergraduate program). The primary differences between these two curricular paths were the presence or lack of presence of NAAB Student Performance Criteria woven into the student learning outcomes and course design, and the degree awarded upon successful completion of the program. For instance, Texas A&M University offers a pre-

		CENTER		
		TAMU	UKY	KU
n=50	**DESCRIPTION**	19	15	16
STUDIO TYPE	Individual	11	7	6
	Individual and Team	4	8	9
	Team	4	0	1
COMMUNITY	Interdisciplinary	5	3	1
	Community-Engaged	5	3	8
PROJECT TYPE	Hypothetical	11	11	6
	Quasi-Real	7	4	4
	Real	1	0	6
NUMBER of PROJECTS		Ranges from 1 to 14	Ranges from 1 to 15	Ranges from 1 to 5
% of GRADE	Variable Weight	15	14	9
	Equal Weight	4	1	7
PORTFOLIO REQUIRED	Yes	10	8	16
	No	9	7	0

Table IV.1: Summary of Syllabus Content Analysis Related to Project Type and Studio, Number of Assignments, % of Final Grade, and Portfolio Requirements.

professional undergraduate degree, a 120 credit hour Bachelor of Environmental Design (BED) that prepares students for “challenging careers in industries supporting the built environment” (Source: http://dept.arch.tamu.edu/undergraduate) and a 52 credit hour Master of Architecture degree, accredited by the National Architectural Accrediting Board (NAAB), qualifying its recipients to take a state professional licensing examination after a required internship period (Source: http://dept.arch.tamu.edu/graduate/master-architecture/index.html). The University of Kentucky program awards a 120 credit hour pre-professional Bachelor of Arts in Architecture en route to a 48 credit hour Master of Architecture (Source: http://www.uky.edu/design/index.php/info/category/architecture/) and the University of Kansas program offers two tracks to a professional degree: a 173 credit hour combined BA/M. Arch (Bachelor of Arts in Architectural Studies—an Undergraduate Certificate in one of KU's specialized programs (Leadership, Entrepreneurship, and Research) and Master of Architecture degree) and a 180 credit hour professionally accredited Master of Architecture degree (M.Arch. I) that can be completed with five years of study. Upon completion, a student is awarded a professionally-accredited degree necessary for becoming a licensed architect. Those who are admitted to the 5-year path enroll in design studio, technical and support classes, and electives each semester (Source: http://architecture.ku.edu/). General overviews of the required curriculum for each of these programs are available online and a specific curriculum map for the University of Kentucky that aligns NAAB SPC per year and per course is provided (Appendix 02).

IV.1.1.1 Design Studio Culture Policy

There was consensus amongst the three institutions in providing active links from the studio syllabi to the program's Design Studio Culture Policy (Appendix 01) as strongly encouraged by the accreditation standards (NAAB, 2014). These Studio Culture policies were developed by the students and supported by the faculty and administration. The policies were meant to enable a strategic work-life balance, promote good time management skills, and improve communication between faculty and students (Koch, 2002).

In reviewing these documents, there appears to be common ground in the central nature of the design studio as an “effective component of architecture education” (TAMU Studio Culture Policy, undated) that enables a student to develop the ability to write, speak, model, draw, and build architecture in a safe and reflective environment of discovery. In this context, the process of design is as equally valued as the end product. Faculty should provide “students with clear criteria for grading that considered a student’s performance over the course of the entire semester not just the final product” (UKY Design Studio Culture Policy, 2012). While this statement exists in the Design Studio Culture policy, there was not consistent data in the syllabus to support this claim.

The Design Studio Culture policies also address the categorization of studio type and project type. Statements within the documents support both individual and collaborative work, and also describe both the mutually supportive and competitive context of the studio. Studio learning encourages “collaboration and risk taking” (KU Studio Culture Policy, 2009) in “a cooperative and competitive” environment where students are expected to produce “individualized and unique work” (UKY Design Studio Culture Policy, 2012). This context expands to include the desire for interdisciplinary collaboration, stating, “the act of design and of professional practice is inherently interdisciplinary, requiring active and respectful collaboration with others” (TAMU Studio Culture Policy, undated). The University of Kentucky extends interdisciplinary collaboration beyond the college explicitly stating “collaboration should be highly encouraged at all levels in the college—between individual students and between studio levels of education," across the university "the college should encourage the inclusion of interdisciplinary faculty and/or partnerships with other disciplines such as engineering, business, product design, art, and landscape architecture," and beyond the university by forming collaborations with other universities" (UKY Studio Culture Policy, 2012).

These documents support the expanded role and context of the design studio as a laboratory for experimentation that impacts the communities that the programs serve. Design studio requires the "rigorous exploration of ideas" and the inclusion of "diverse viewpoints" (KU Studio Culture Policy, 2009) by encouraging "studio involvement in the community to influence design's effect on the community at-large" (UKY Studio Culture Policy, 2012).

IV.1.2 Focus Groups Data Observations

Focus groups were conducted with a total of thirty-two (n=32) design studio faculty in three institutions – eight from the Department of Architecture at the Texas A&M University-College of Architecture (TAMU) representing 42% of the faculty teaching design studio in the spring 2016 semester, six from the School of Architecture at the University of Kentucky-College of Design (UKY) representing 40% of the faculty teaching design studio in the spring 2016 semester, and eighteen (includes six faculty who teach design studio, but not in the semester of interest) from the Department of Architecture at the University of Kansas-School of Architecture, Design, and Planning (KU) representing 75% of the faculty teaching design studio in the spring 2016 semester.

IV.1.2.1 Overview of Focus Group Data Observations

A content analysis of the transcripts of the three faculty focus groups (one with each of the research centers) was conducted to produce evidence that defined the educational methods employed by faculty who teach design studios.

Each of the faculty focus groups followed a structured interview protocol (Appendix 03) in which faculty were asked to respond to thirteen questions. Questions were grouped into several themes: categorization (types of studio, types of projects), design pedagogy (the number of assignments per semester, demonstrated link between studio learning objectives and accreditation performance indicators (SPCs), interaction with clients/community), knowledge exchange (students, faculty, and reviewer expectations, degree of community involvement in the juried reviews), and assessment (process and product of the studio, student learning outcome measurement, and rubric usage). Discussion was allowed to unfold naturally before starting the next question. The focus group sessions were targeted to be between one and a half and two hours duration but were actually as follows: TAMU (2:01:54), UKY (2:07:30), and KU (1:20:08).

Following the faculty focus groups, the recordings were transcribed. These transcriptions were initially organized around the responses to the common questions that addressed categorization, design pedagogy, knowledge exchange, and assessment. Following this organization, a supplemental coding enabled the researcher to identify emergent themes related to faculty nimbleness, portfolio review, curricular connections, and student success.

Faculty nimbleness was defined as the ability of the faculty to take the pulse of the studio on a daily basis and to respond to apparent lacks in knowledge independent of the expected outcomes. Several faculty noted the importance of being able to determine the lacunae in the student's knowledge and fill them. Similarly, through the jury review process, faculty identified an opportunity to share curriculum knowledge by nurturing and building the capacity of their faculty colleagues.

The discussions revealed two strategies for portfolio review: the process notebook (individual students) and the studio publication (collective studio). The process notebooks and the student publication provided additional insights into the way that studios work. The process notebooks enabled the student to document the entire studio process and to allow both student and faculty to see how the students' projects moved from idea to implementation. These notebooks were different from the curated studio publication where students tended to "identify their precision and their strengths" (TAMU Focus Group, 2016). While there was stated unanimous consensus on the necessity to grade the process and the product of the design studio, there was little evidence to support the equal valuation of those two items. Unless explicitly stated in the syllabus, there was little evidence for a rigorous link between the process and the final product and often determination of final assessment was made in comparison to other students in the studio.

IV.1.3 Faculty Interview Data Observations

Interviews were conducted with a total of fifteen (n=15) design studio faculty in three institutions – four from the Department of Architecture at the Texas A&M

University-College of Architecture (TAMU), two from the School of Architecture at the University of Kentucky-College of Design (UKY), and nine from the Department of Architecture at the University of Kansas-School of Architecture, Design, and Planning (KU).

IV.1.3.1 Overview of Interview Data Observations

A content analysis of the transcripts of the fifteen interviews was conducted to produce evidence that defined the educational methods employed by faculty who teach design studios.

Each of the faculty interviews followed a structured interview protocol (Appendix 04) in which faculty were asked to respond to eleven questions. Questions were organized into the following themes: the categorization of studio type and project type, an examination of the interdisciplinary nature of the studio, an alignment of studios with the faculty's design pedagogy, and the faculty use and understanding of an evaluation rubric. The interview questions were developed to include the individual faculty's design studio perspectives along with the collective consensus that emerged from the focus group discussions. The open-ended interview questions were also designed to get a better sense of why and how student outcomes (artifacts) develop in the architectural studio context and what role community engagement plays in a student's education. Discussion was allowed to unfold naturally before starting the next question. The TAMU interviews ranged from 24:51 to 1:21:53 in length. The UKY interviews ranged from 32:57 to 1:39:05 in length. The KU interviews ranged from 27:01 to 45:00 in length.

Following the faculty interviews, the recordings were transcribed. These transcriptions were initially organized around the responses to the common questions of the themes: categorization, interdisciplinary collaboration, design pedagogy, and assessment rubrics. Following this organization, supplemental coding enabled the identification of additional emergent themes.

Architectural education is “culturally less like a snake and more like an onion, in the sense that we do not shed layers and then grow a new one. Like an onion . . . we keep adding layers. We get bigger, more intensive, and deeper, especially when we have direct contact with the world in terms of real projects” (KU Interviews, 2016). Faculty described the increasing complexity and the need to fit it all inside of an academic calendar as being challenging, yet critical to design education especially in preparation for professional licensure. “Students are charting their own kind of critical thinking path through design. The students are seeking out problems, defining what those problems are, and addressing them in a meaningful way through design. This is something that, increasingly, professionals have to do” (KU Interviews, 2016).

Similar to professional practice, the success of a project does not always fit in the sequence of the academic calendar. Scott Veazey, President of the National Architectural Accrediting Board, past President of the National Council of Architectural Registration Boards, and Partner Emeritus at VPS Architecture states, “So often in the real world, it's a long time before you realize that your project was a successful collaboration with the community that you served” (Personal Communication, 09 February 2016). The structure and timing of these learning experiences are typically under the purview of the program’s curriculum. In an accredited program, the curriculum is coordinated with NAAB Student Performance Criteria (SPC) and each course identifies the criteria that will be met by that course (Appendix 02). David Biagi, the Chair of the School of Architecture at the University of Kentucky described UKY’s approach to NAAB SPC integration into the curriculum, “If one looks at the NAAB criteria in terms of an overall curriculum, the intent is to strategically deliver content that's specifically measurable over a cumulative period of time” (Personal Communication, 13 April 2016). Therefore, SPCs are meant to provide a holistic point of view of how architects think and view the world. In the studio, SPCs are targeted towards specific content at the appropriate moment in the educational process so that they can be built upon and developed. However, meeting SPCs does not necessarily equate to a successful building. As SPCs are minimum standards, and faculty overwhelmingly expressed that transcending the SPCs is actually a metric of a program success. “Health, safety, and welfare of the public are essential components of practice. We need to make sure that the students understand the consequences of their design decisions are greater than just the decision that they're making in the classroom” (TAMU Interviews, 2016). “We are giving students the tools to create future discovery” (KU Interviews, 2016). To further express this pedagogical approach, David Biagi stated, “The agenda of the overall education of an architect should be written into the curriculum, and the contribution of the course to that curriculum should be explicitly conveyed in the syllabus” (Personal Communication, 13 April 2016).

Through the content analysis of studio syllabi, the common syllabus emerged as an important topic. When queried about the role of the common syllabus and the opportunities that a shared framework provided to faculty and students, faculty responded "by covering materials that are required by university policy and accreditation standards, a foundation is provided to the faculty from which a given year can present shared themes and learning objectives. This structure also frees the faculty to deliver appropriate content in the manner that fits their pedagogy and the given project. It also provides the students with the necessary room to express themselves" (KU Interviews, 2016). Search and discovery also emerged as two integral components of the design studio education and central themes of the student's self-presentation and self-expression. "It is important for the students to find and challenge their own limits while advancing the project and developing themselves" (UKY Interviews, 2016). By structuring the design studio experience and by setting aspirational goals for the students, the faculty "scaffolds the student learning experience, teaches students how to create, manage a project, and understand the healthy nature of debate in architecture" (KU Interviews, 2016).

Personal development and the ability to be self-critical is an essential trait for a successful design student. Student self-criticality was noted by the faculty as being one of the most difficult traits for a student to develop. David Biagi elucidated, "The hardest thing for any designer, I believe, is to become self-critical. There is a really interesting transitional stage between incoming students and graduating students. Successful students are the ones who at a certain point in their career, realize that they can step back and become self-critical of their own work in a way that isn't only critiquing the project from a love-hate relationship, but rather, judge it against a set of criteria, to have the wisdom to determine if the project meets those criteria, and the confidence to support their decisions" (Personal Communication, 13 April 2016). Design faculty provide motivational guidance and challenge their students to aspire to and achieve at a higher level by presenting students with content that makes the student think and create at different scales. "Faculty are the drivers of the course content, but students create intensity for themselves" (KU Interviews, 2016). This intensity aligns with the design thinking practices of the profession and links to the topic of persistence. Persistence is defined as "overcoming difficulties in the pursuit of a goal" (Fay & Frese, 2001). In order to demonstrate persistence, students must value the assignment and leverage pre-existing knowledge, which are essential components of a student's self-efficacy. Students are using the design studio as a mechanism for thinking and discovery. "Students are charting their own critical thinking path through the design program, rather than just responding to a design prompt with a solution to a problem that they've been given" (KU Interviews, 2016).

The design studio was described as an ideal venue for synthesis of knowledge to take place. In addition to categorization, interdisciplinary collaboration, design pedagogy, and assessment rubrics, there were three emergent themes: role playing by the faculty, the measureable impact of integrative approaches for community engagement, and the value of applied design research in design studio instruction.

The theme of role-playing emerged in the syllabus content analysis where students were asked to assume the role as the developer of quasi-real project. Role-playing also emerged in the interviews where faculty served many roles in the studio. All too often faculty "end up wearing too many hats" (KU Interviews, 2016). In terms of pedagogy, the faculty roles include: the deliverer of content, the facilitator of communication, the mediator of student engagement, and the studio peacekeeper during architectural debate and criticism. The faculty also serves as the conduit between the student and the consultant working to integrate specialized knowledge into the studio This role was described as "helping the student to visualize both horizontal and vertical integration of performative relationships and how it relates back to their concepts" (UKY Interviews, 2016). In relation to quantifying the measurable impact of integrative approaches for community engagement, there were no rigorous methods for determining value beyond "Full-scale prototypes are really important for the community to see" (KU Interviews, 2016).

On the value of applied design research in design studio instruction, faculty described a recent series of studio projects at Texas A&M that used a common syllabus but had different approaches to designing a state-of-the-art, multipurpose practice facility for the NBA Dallas Mavericks. The four studios iteratively produced designs for a mixed-use development, team store, museum and theater, office space, conference rooms, and incubator for start-up companies in addition to the more traditional practice facility amenities. In these studios, the students worked directly in reviews with Mavericks owner Mark Cuban and architect Bryan Trubey, the executive Vice-President, Director of Sports and Entertainment at HKS Inc. and the project's lead architect. Faculty who led the design studios were integrally involved in the project's development. At the end of the studio, the faculty were asked to assign scores to site, program and client ranging from 0 hypothetical to 50 quasi-real to 100 real. Similarly, the faculty were to assign scores for community engagement with 0 community not-engaged (no community involvement) to 50 partially-engaged (community involved in design reviews only) to 100 fully-engaged (community involved in studio work to realize common objectives through brainstorming, reviews, community presentations, feedback, and learning outcomes that demonstrate clear community benefit). Faculty were also asked to assign a rating to describe the extent of the project's realization from 0, unbuilt (drawn-only, not modeled or constructed), to 50, partially-built (drawn and modeled at some scale, but not at full-scale), to 100, built (drawn and modeled, and then constructed at full-scale). Faculty were also asked to assign a rating to describe the method of working in the studio ranging from 0 individually only to 50 both individually and in teams to 100 team work only. Two of the four faculty involved with the project responded with consensus rankings for program, client, community-engagement, but differed on the hypothetical nature of the site, the nature of the realization, and the student's mode of working, individually or in teams. This variation parallels the theme of faculty independence that emerged from the syllabi, content analysis, focus groups, and interviews. This individuality allows the faculty to decide on the appropriate means of project delivery that aligns with their own pedagogy enabling a guided mastery (Bandura, 1997).

IV.2 Quantitative Methods

Quantitative data was collected through two surveys (pre- and post-) and scoring of student work. Each of these requests was made using the Qualtrics electronic system.

IV.2.1 Student Surveys (Design Self-Efficacy, Predispositions, Studio Type, and Project Type)

This research included development and application of an instrument for measuring Design Self-Efficacy (DSE) in architectural design studios and then tested it for content, construct, and criterion validity. The survey instrument (Appendix 09) included Design Self-Efficacy (DSE) items; a predispositions survey; and studio type and project type questions that were a part of the second survey. The use of the SPC and its theoretical alignment and the subsequent categorization of DSE items were supported through consensus agreement in the focus group discussions and interviews with design studio faculty at TAMU, UKY, and KU.

IV.2.1.1 Overview of Survey Data Observations

In total, six hundred eighty-seven (687) students were recruited to participate. The target sample size of 340 students who would complete a consent form and participate in the pre-treatment survey and the post-treatment survey is roughly 50% of the total number of students enrolled in architecture design studios at the TAMU, UKY, and KU. The actual response rate for the pre-treatment survey was two hundred sixty-two students (n=262) (38.1% of the number of students enrolled at the three institutions). This number separates as follows: one hundred forty-two respondents from TAMU (41.7% response rate); sixty-one respondents from UKY (36.5% response rate); and fifty-nine respondents from KU (33.5% response rate). A comparison of means revealed common trends between the three institutions and the nine lowest scored DSE items. These items included: *DSE_19 Prepare outline specifications, DSE_21 Demonstrate the mechanics and material behavior related to building structures through drawings, details, and structural analysis, DSE_22 Utilize the principles of environmental systems to develop designs for an environmentally responsive building for a given geographic region, DSE_26 Predict the effectiveness of a design if implemented, DSE_30 Determine the applicable building code, occupancy group(s), and construction type, DSE_31 Determine allowable area and height, DSE_32 Calculate occupant load, DSE_34 Check egress paths for travel distance, and DSE_36 Talk about specific parts of my drawings, models, and other visuals* (Figure IV.1).

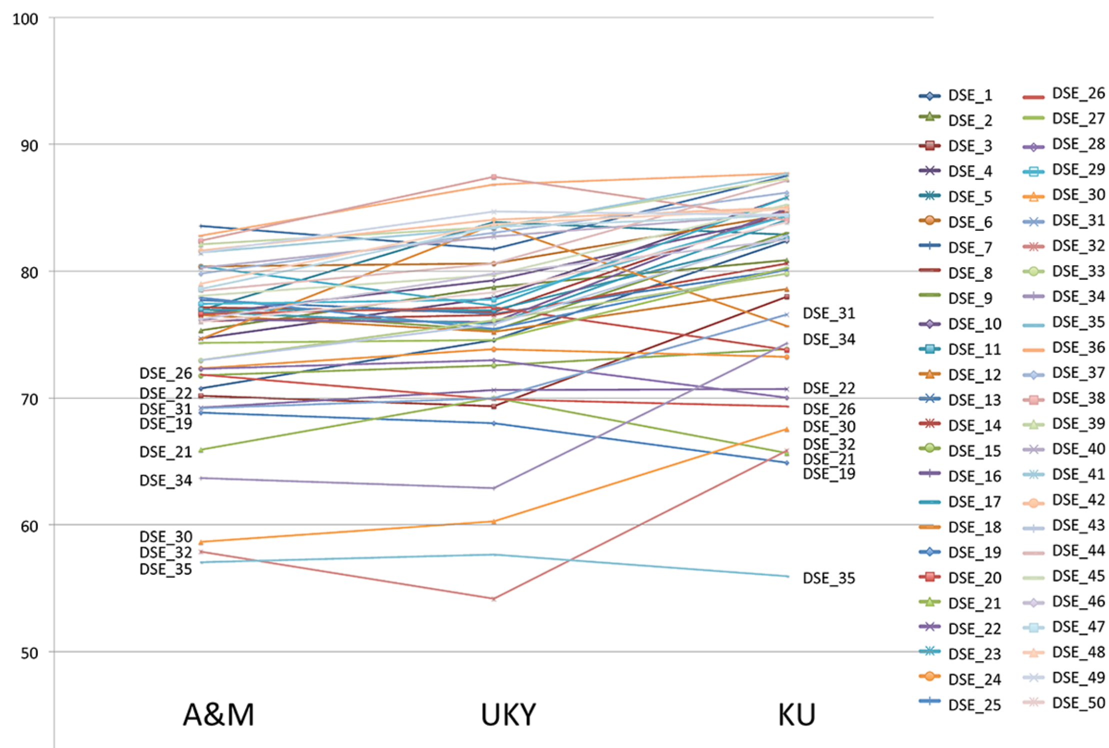

Figure IV.1 DSE-M Score Comparison of Means Between TAMU, UKY, and KU – Lowest Reported Pre-Treatment Survey Results

A second survey was distributed three weeks prior to the end of the semester. The same recruitment processes were used and all of the studios were visited at the beginning of the class session. The actual response rate for the post-treatment survey was one hundred one students (14.7% of the number of students enrolled at the three institutions). Of this number, eight-four respondents were from TAMU (24.5% response rate) and seventeen respondents were from UKY (10.1% response rate). Due to unforeseen issues, the second survey was not distributed completely; therefore there were no respondents from KU (0.0% response rate). Given the lack of participation of the University of Kansas in the second survey, the number of participants in the study represented 19.8% of the student population enrolled in architectural design students at

TAMU and UKY. The actual response rate for students who completed both the pre-treatment survey and the post-treatment survey was seventy respondents consisting of fifty-nine from TAMU (17.2% response rate), eleven respondents from UKY (6.54% response rate), and zero respondents from KU (0.0% response rate). A comparison of means revealed common trends between TAMU and UKY between the eight lowest scored DSE items. These items included: *DSE_19 Prepare outline specifications, DSE_21 Demonstrate the mechanics and material behavior related to building structures through drawings, details, and structural analysis, DSE_22 Utilize the principles of environmental systems to develop designs for an environmentally responsive building for a given geographic region, DSE_30 Determine the applicable building code, occupancy group(s), and construction type, DSE_31 Determine allowable area and height, DSE_32 Calculate occupant load, DSE_34 Check egress paths for travel distance, and DSE_35 Determine Fixture Counts* (Figure IV.2).

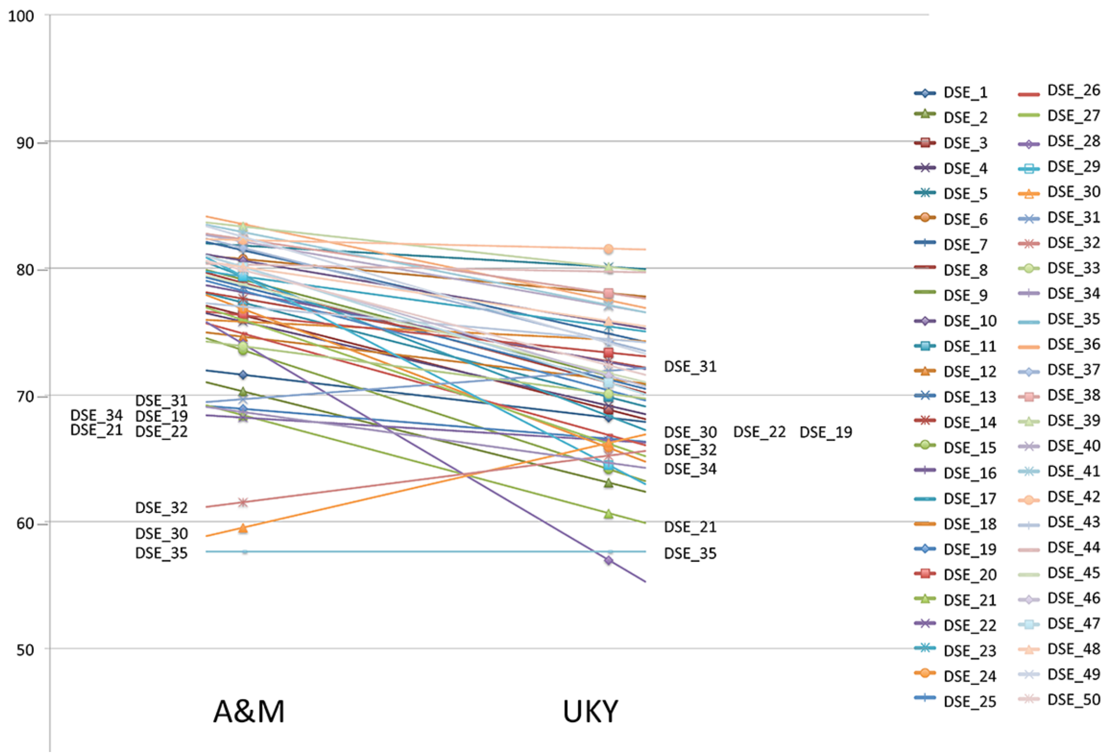

Figure IV.2 DSE-M Score Comparison of Means Between TAMU and UKY – Lowest Reported Post-Treatment Survey Results

The demographic profiles for TAMU and UKY students were connected to the de-identified survey responses. However, the KU demographics were not connected to the pre-treatment survey responses and therefore are not included in the table. The age of the respondents ranges from 18-29. The overall population included two hundred twenty-nine undergraduate students and seventy-four graduate students (U1=32; U2=54; U3=53; U4=90; and G7=74), 120 female and 89 male, 130 White/Caucasian, 39 Hispanic or Latino, 24 International, 8 African-American, 6 Multi-Racial, 4 Asian, and 1 American Indian (Table IV.2).

		Center			
		TAMU		UKY	
		Pre	Post	Pre	Post
Classification	Graduate	30	26	15	3
	Undergraduate	111	58	46	14
Classcode	G7	30	26	15	3
	U4	45	23	17	5
	U3	28	14	10	1
	U2	23	12	13	6
	U1	15	9	6	2
Gender	Female	87	x	26	7
	Male	54	x	25	10
Race/Ethnicity	White	71	x	43	16
	African American	2	x	6	0
	Multi-Racial	5	x	1	0
	Hispanic or Latino	36	x	3	0
	American Indian	0	x	1	0
	Asian Only	4	x	0	0
	International	22	x	2	0
	Unknown	1	x	1	1

Table IV.2 Demographic Distribution Pre-Treatment and Post-Treatment Surveys TAMU and UKY.

IV.2.1.2 Argument for Reliability and Validity

The initial mode of validation is a comprehensive literature review that supports the method of adapting an existing self-efficacy survey instrument to the context of an interdisciplinary and collaborative integrated design studio. The Spring 2015 pilot study used the proposed survey instrument, aligned student learning outcomes with assessment rubrics, aligned interdisciplinary coursework, and obtained baseline data for analysis.

The assessment of research data enabled the construction and assessment of the dimensionality and reliability of measuring self-efficacy in the proposed studio type and context by pre-testing and post-testing students for their collaborative dispositions validity through correlation.

The construct validity was addressed by aligning the task-specific items, measures of motivation, anxiety, and confidence drawn from self-efficacy literature review of previous self-efficacy measures conducted by Albert Bandura (Bandura, 1997), Tufts and Purdue University (Carberry, Lee, & Ohland, 2010) to theoretical predictors of outcomes (project scores). The resulting instrument (Appendix 09) used Bandura's 0 to 100 response format.

IV.2.2 Project Score Observations

This dissertation uses the assumption that Grade Point Average (GPA) is not an effective or rigorous measure of student success in the architectural studios. As revealed in the faculty focus groups and interviews, the standards for an "A" varies greatly in the ways that grades are assigned and therefore the development of a project-scoring rubric appears to be a more valid way of assessing student artifacts that are produced in architectural design studios.

IV.2.2.1 Overview of Project Score Data Observations

In total, six hundred eighty-seven (687) students were recruited to participate in the submission of studio artifacts. The student artifact collection process was less robust than expected. Instead of 262 students (who participated in the pre-treatment survey) or the 101 students (who participated in the post-treatment survey), there were only 6 students (2 from each center) who responded to the call for student projects (artifacts). The actual number of submissions was six students, which represents less than 1% of the total number of students enrolled in architecture design studios at the TAMU, UKY, and KU. Four evaluators of varying teaching and professional experience using a rubric developed for this research reviewed these artifacts.

IV.2.2.2 Argument for Reliability and Validity

The purpose of the rubric focused on making the evidence of the design process explicit and reviewable in the submitted artifact. The rubric provided language to guide the evaluator in assigning scores for each of the rubric categories. To address the validity of the project-scoring rubric, each of the artifacts was assigned to each of the nineteen evaluators. Because AQUA is not designed to allow for nineteen evaluations per submission, each artifact was uploaded nineteen times. This created an AQUA-based assignment per each artifact with a total of six assignments assigned to each of the nineteen evaluators to score. Of the nineteen evaluators, four evaluators completed the evaluations for the six assignments. The evaluation process allows the results to be filtered by each student artifact. The AQUA system also generated an evaluator reliability report to assess score distributions per criterion for each artifact.

To further confirm the validity of the rubric instrument, both inter-rater and intra-rater reliability measures and post-evaluation interviews with the evaluators were incorporated in the analysis of the instrument. The project score distribution is presented both by criterion (Figure IV.3) and by average score by criterion (Figure IV.4).

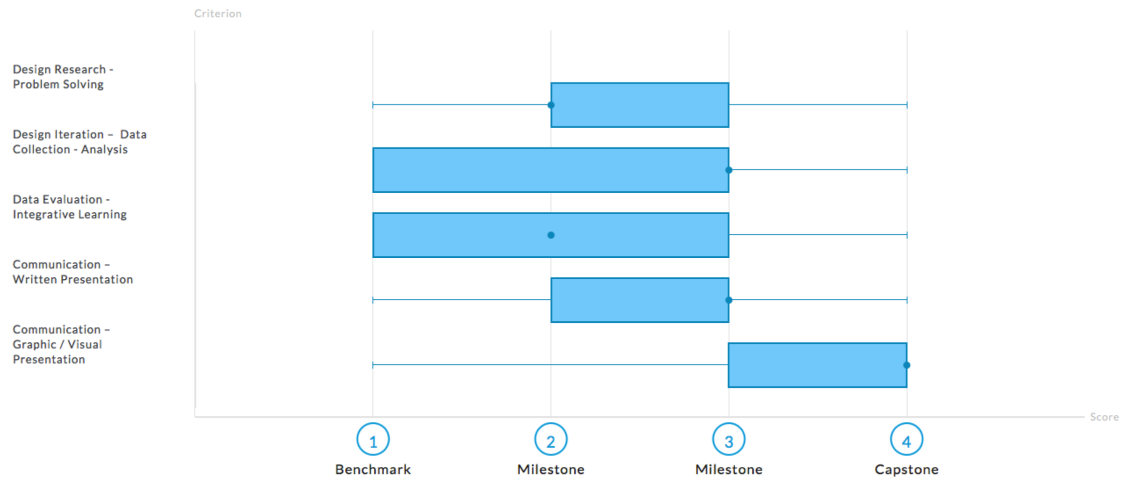

Figure IV.3 Project Score Distribution of Submitted Projects by TAMU, UKY, and KU – By Criterion

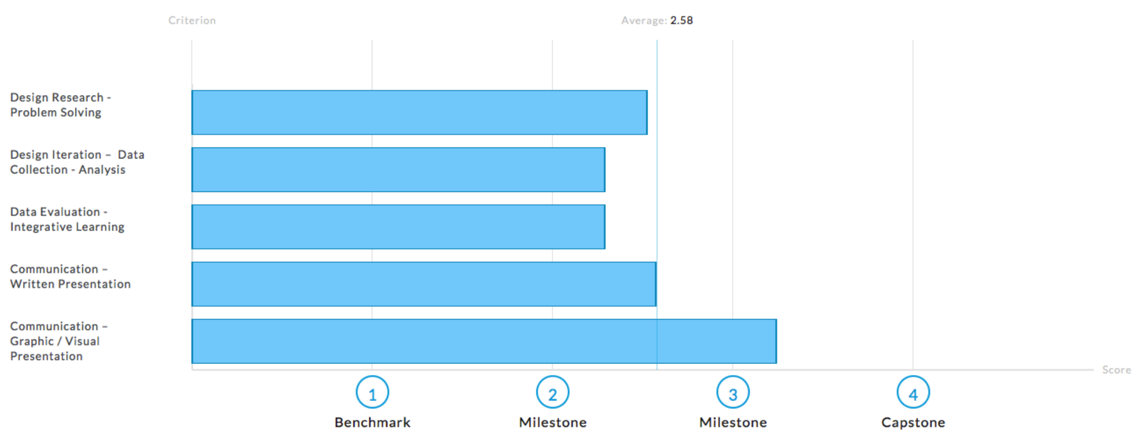

Figure IV.4 Project Score Distribution of Submitted Projects by TAMU, UKY, and KU – Average By Criterion

IV.3 Summary of Data and Observations

Using both qualitative and quantitative methods to collect and assess data has led to the following observations that are discussed in the chapter on data analysis.

Based on the focus groups and interviews, there is strong consensus among faculty and administrators who participated in the study, that NAAB SPC can be aligned to measures of self-efficacy (Appendix 10), adhere to the theoretical underpinnings of self-efficacy research, and have both theoretical and construct validity related to the discipline and practice of architecture. The items produced for the research also reflect domain-specific activity related to the production of architecture. The concepts of motivation, persistence, value to the student, familiarity of tasks, and previous success aligned with completing those tasks are analyzed in the next chapter, both per-item and per-group. This analysis is done horizontally within the student participant and vertically between participants.

Based on the focus groups and interviews, there is strong consensus among faculty and administrators who participated in the study, that studio type and project type can be categorized. The methods of working or context of the studio range from individually only to individually and collectively to team-only. The methods appear to correlate to the degree of complexity of the project and the level of the student. Similarly the hypothetical and realness of the studio content or project type, appears to correlate to the degree of complexity of the project. Unless explicitly articulated in the syllabi, the context (ST) and the content (PT) of the studio are implicitly conveyed.

Further statistical analysis is presented in the data analysis chapter to demonstrate the demographic effect (age, race, ethnicity), the year effect (graduate levels G7 and undergraduate level U4, U3, U2, U1), and the group effect (theoretical grouping: 1) response to design constraints and design evolution, 2) the development of ideas in architectural terms, and 3) the presentation of ideas in drawings and models.

The interviews and focus groups revealed the potential pedagogical benefit of measuring pre-existing student knowledge and skills as the students move from year to year. The existing methods for assessing student knowledge that emerged from the syllabi content analysis, focus groups, and interviews include: studio process notebooks, end of year studio portfolios, and quick studio exercises that provide insights for faculty in subsequent studios.

As revealed in the faculty interviews, there was discussion that a student's predisposition for collaboration (PD) may correlate to the types of studios that they participate in. "Students may unknowingly possess a pragmatic trait that enables them to gravitate towards certain types of studios or projects" (UKY Interviews, 2016). A self-assessment measurement instrument for individualism and collectivism (Singelis, Triandis, Bhawuk, & Gelfand, 1995) was integrated into the research and was used to correlate a student's predispositions to studio type, project type, and self-efficacy. The analysis of predispositions may provide additional insights for faculty to understand and assess what a student brings into the studio with them. Further statistical analysis is presented in the data analysis chapter.

CHAPTER V

DATA ANALYSIS

This chapter includes the data analysis used to provide facts and arguments relevant to the hypotheses. Each subchapter introduces the appropriate analytical technique, whether statistical, content, or qualitative analysis, and presents the significance, validity, and reliability of the analysis in establishing the findings. This chapter will conclude with a summary of the analyses that inform the dissertation conclusions and outline areas of future research beyond the dissertation.

V.1 Discussion of Data Analysis

This dissertation relies upon the assumption that self-efficacy is a metric for measuring student success in the architectural studios. This research is formulated around two primary research questions:

1. Does the architecture design studio context influence self-efficacy?
2. Do collaborative projects increase self-efficacy?

The research questions were examined and tested using content and statistical analysis where appropriate. The results of the analyses are presented with the research, the hypotheses that were tested, and the data that was analyzed to determine the outcomes and contributions.

V.2 Syllabi Content Analysis

A content analysis of the syllabi was conducted to produce data and evidence that define the educational methods employed. A syllabus review rubric suggested by Stanny

(Stanny, Gonzalez, & McGowan, 2015) was used to outline the required components and best practice components. A supplemental analysis was performed to identify learner-centered approaches that promote student success (O'Brien, Millis, & Cohen, 2008).

The syllabi were initially assessed for three criteria: required institutional materials (dictated by University policy), best practice materials (faculty modified components), and learner centered materials (design pedagogy). All syllabi included what Stanny refers to as the *bones* of the syllabi content that are defined by institutional policy (Stanny, Gonzalez, & McGowan, 2015). The required institutional material included the:

- Course Title;
- Course Number;
- Number of Credit hours;
- Term;
- Year;
- Course Description (from University Registrar's office);
- Listing of Prerequisite Courses (for upper level courses);
- Course Meeting Times;
- Studio Location;
- Instructor Information (Name, Telephone Number, E-mail address, Office hours, Office location);
- Textbook and/Required Resource Materials;

- Course Schedule (including assignment due dates);
- Listing of Required and Recommended Readings;
- Americans with Disabilities Act (ADA);
- Studio Culture Statement;
- NAAB SPC Criteria addressed by the course (for accredited programs); and
- Learning Outcomes or Course Objectives.

The best practices of faculty-modified topics include:

- Academic Integrity;
- Attendance Policies;
- Grading Policies;
- Care of Facilities;
- Official University Regulations;
- Important Links (including referenced links such as: Department of Architecture website, Department of Financial Assistance, Academic Calendar, Final Exam Schedule, Online Catalog, Student Rules, Aggies Honor System Office (TAMU), American Institute of Architecture website, and American Institute of Architecture Students website);
- Workshop Certification policy;
- Cellphone Policy; and
- Content-specific Links (reference materials – theory, materials of construction, exterior envelopes).

The learner-centered high-impact items, which are often characteristic of design studio education, included: multi-modal communication integration strategies, field trips, desk crits (faculty student conversations), pin-ups (general discussion, informal review, peer-to-peer feedback), and reviews (formal, response to criticism).

The items that appeared the least often were:

- Supplemental Learning Objectives;
- Weekly Learning Objectives;
- Grading Policies (process versus product);
- Assignment-specific Assessment and Grading policies (value per assignment);
- Matching Course Objectives to Weekly Learning Objectives;
- Performance Evaluations;
- Links to external sources that would be necessary to access in order to complete the project;
- Links to significant events that would be useful to complete or enhance their completion of the course assignments (Lectures, Symposia, Workshops);
- Required Tools or Suggested Equipment;
- Late Work Policy;
- Statement of Course Topic or Project Abstract (beyond the registrar's course description);
- Link between precedents, analysis, and synthesis;

- Listing of studio components (research, conceptual development, design, methods of implementation);
- Materials (digital, software, physical);
- Course Costs (estimated costs to be spent in studio);
- Changes to Studio Schedule announcement process; and the
- Required written component of studio projects.

V.3 Hypotheses Testing

The data analysis is organized as a search for hypotheses that emerge from undertaking various steps to reveal correlations and patterns in the data:

- Mapping NAAB Student Performance Criteria to a validated self-efficacy instrument;
- Measuring self-efficacy in the context of an architectural design studio;
- Categorizing studio type and project based upon their interactions, attributes, and features;
- Statistically analyzing the impact of studio type and project type on the obtained self-efficacy measures;
- Correlating predisposition for collaboration across self-efficacy, studio type, and project type;
- Objectively measuring project score using a rubric;
- Correlating the relationship between project score and self-efficacy; and
- Testing for correlation between demographics and self-efficacy.

To analyze the stated hypotheses, four basic statistical tools were used: regression, ANOVA, T-test, and correlation (Pearson's and Spearman's). The analysis methods utilized include: dimension reduction techniques (to reduce the self-efficacy measures into lower dimension), multivariate multiple regression (to see the effect of predisposition on self-efficacy and effect of self efficacy on project scores) and multivariate matched paired test (for pre-treatment and post-treatment Design Self-Efficacy and how it is affected by predisposition for collaboration).

A discussion of the hypothesis testing and the data analysis follows.

V.3.1 Student Performance Criteria (SPC) Can Be Mapped to Design Self-Efficacy (DSE)

The four realms identified by NAAB are Critical Thinking and Representation; Building Practices, Technical Skills, and Knowledge; Integrated Architectural Solutions; and Professional Practice (NAAB, 2014). Each of these realms has specifically identified learning outcomes. These learning outcomes are stated in one of two levels: understanding or ability. The criterion validity focused on the design specific tasks necessary to complete a project:

- Gather relevant information to a given design project;
- Develop a needs assessment and building program;
- Respond to site-specific characteristics that may inform the design;
- Determine allowable area and heights given code constraints;
- Select and analyze appropriate precedents;
- Connect data from those analyses to project constraints;

- Develop a design solution;
- Iteratively develop the designs through a critical evaluation;
- Construct models that illustrate the design solution;
- Produce drawings using architectural conventions appropriate to the size, scale, and complexity of the design solution; and
- Effectively communicate the design solution through written, oral, and graphic means of communication.

Content validity derives from showing correspondence to the representation of the architectural design process. The specific steps are to examine models of the architectural design process both outside and inside of the academic realm. Analysis consisted of applying: the legal description of architectural process, the educational perspectives of Hoesli, and the NAAB SPC to establish construct validity.

The translation from twenty-six SPC to fifty DSE measures reflect a best practice of both assessment methods and of self-efficacy measures to articulate what is exactly being measured to ensure that the instrument has validity and reliability. An example would be NAAB SPC A.1 - Professional Communication Skills: Ability to write and speak effectively and use representational media appropriate for both within the profession and with the general public (NAAB, 2014). This SPC has been separated into six measures that capture a student's capability: 1) ability to write effectively within the profession, 2) ability to write effectively for the general public, 3) ability to speak effectively within the profession, 4) ability to speak effectively for the general public, 5) ability to use representational media appropriate within the profession, and 6) ability to use representational media appropriate for the general public. Similar reasoning is applied for all twenty-six SPC. Table V.1 contains the NAAB SPC, Task Definition, and DSE Code for Design Self-Efficacy Mastery (DSE-M) items DSE1-DSE25. Table V.2 contains the NAAB SPC, Task Definition, and DSE Code for Design Self-Efficacy Mastery (DSE-M) items DSE26-DSE50.

As seen in tables V.1 and V.2 often the DSE-M measures relate to two or more Student Performance Criteria. There are one-to-eighteen mappings between a DSE-M measure and a NAAB SPC. The rationale for this overlap is that while the SPC might have a different code, a task or subtask to complete the SPC may actually be similar in terms of its assessment. An example that conveys this overlap would be DSE_8 *I can select appropriate precedents*. In order to select appropriate precedents, a student would need to understand the design problem, use research and investigative skills to identify precedents, would need to study and understand the precedents, and then evaluate their value to a given site and culture, and evaluate the appropriateness of a choice on how to align the lessons learned from that analysis into a given project.

DSE SE Code	TASK Definition *[I can . . .]*	NAAB SPC
DSE_1	Use effective oral communication that is appropriate for other people within the profession.	A.1, B.10, C.1
DSE_2	Use effective oral communication that is appropriate for the general public.	A.1, B.10, D.1
DSE_3	Write effectively for an audience of other designers.	A.1, B.1, B.10, C.1
DSE_4	Write effectively for the general public.	A.1, B.10, D.1
DSE_5	Use representational media (e.g., models, drawings) that is appropriate for other designers.	A.1, A.2, A.3, A.4, B.1, B.2, B.3, B.4, B.5, B.6, B.7, B.8, C.1
DSE_6	Use representational media (e.g., models, drawings) that is appropriate for the general public.	A.1, B.1
DSE_7	Gather information relevant to a project	A.2, A.3, A.6, A.8, B.1, B.2, B.5, B.6, B.7, B.8, C.1, C.2, C.3
DSE_8	Select appropriate precedents.	A.3, A.6, A.7, A.8, C.1
DSE_9	Thoroughly analyze the precedents I choose for a project.	A.2, A.3, A.6, A.7, A.8, C.1
DSE_10	Connect my precedents to the design project I am completing.	A.2, A.3, A.6, A.7, A.8, C.1
DSE_11	Translate what I see in precedents to develop a range of solutions.	A.2, A.3, A.4, A.6, A.7, A.8, C.1
DSE_12	Critically evaluate my iterations.	A.2, A.3, A.7, B.1, B.2, B.3, B.5, B.6, B.7, B.8, C.1, C.2, C.3
DSE_13	Collect relevant information to support conclusions related to a specific project	A.2, A.3, A.7, A.8, B.1, B.2, B.5, B.6, B.7, B.8, B.9, B.10, C.1, C.2, C.3
DSE_14	Use formal, organization, and environmental principles to inform my design.	A.2, A.,4, A.5, A.7, B.1, B.2, B.5, B.6, C.1, C.2, C.3
DSE_15	Apply the fundamentals of ordering systems to natural and formal ordering systems.	A.2, A.4, A.5, B.1, B.2, B.5, B.6, C.1, C.2, C.3
DSE_16	Identify relevant precedents for a project.	A.2, A.3, A.6, A.7, A.8, C.1
DSE_17	Use principles derived from precedents to inform my design projects.	A.2. A.3, A.4, A.5, A.6, A.7, A.8, C.1, C.2, C.3
DSE_18	Create technically clear drawings	A.1, A.4, B.1, B.2, B.4, B.5, B.6, B.7, B.8, B.9, C.1, C.2, C.3
DSE_19	Prepare outline specifications	A.1, B.4, B.8
DSE_20	Construct models that illustrate and identify all necessary information for a building design	A.1, A.4, A.5, B.1, B.2, B.4, B.5, B.6, B.8, C.1, C.2, C.3
DSE_21	Demonstrate the mechanics and material behavior related to building structures through drawings, details, and structural analysis.	A.1, A.2, A.3, B.4, B.6, B.7, B.9, C.1, C.2, C.3
DSE_22	Utilize the principles of environmental systems to develop designs for an environmentally responsive building for a given geographic region.	A.2, A.3, A.4, A.7, B.1, B.2, B.4, B.6, B.7, C.1, C.2, C.3
DSE_23	Identify the design problem	A.2, A.3, A.4, A.7, B.1, B.2, B.6, B.7, B.8, C.1
DSE_24	Set evaluative criteria for possible designs	A.2, A.3, A.4, A.8, B.1, B.2, B.3, B.6, B.7, B.8, B.10, C.1, C.2, C.3
DSE_25	Analyze designs using set criteria	A.2, A.8, B.1, B.2, B.3, B.6, B.7, B.8, B.10, C.1, C.2, C.3

Table V.1 Design Self-Efficacy (DSE) Operational Structure Connecting Self-Efficacy to National Architectural Accreditation Board (NAAB) Student Performance Criteria (SPC) for DSE Items 1-25

DSE SE Code	TASK Definition *[I can . . .]*	NAAB SPC
DSE_26	Predict the effectiveness of a design if implemented.	A.2, A.8, B.1, B.2, B.3, B.6, B.7, C.1, C.2, C.3
DSE_27	Make design decisions in complex projects while considering the variety of influences (e.g., accessibility, environmental systems, structural systems).	A.3, A.4, A.5, A.7, B.1, B.2, B.4, B.5, B.6, B.7, B.9, B.10, C.1, C.2, C.3
DSE_28	Develop a user needs assessment and analysis to respond effectively and efficiently to stated project requirements.	A.3, A.4, A.7, B.1, B.8, B.10, C.1, C.2, C.3
DSE_29	Respond to specific site characteristics in my designs.	A.2, A.3, A.4, A.7, B.1, B.2, B.5, B.6, , C.1, C.2, C.3
DSE_30	Determine the applicable building code, occupancy group(s), and construction type	A.3, A.4, B.1, B.3, B.4, B.9
DSE_31	Determine allowable area and height	A.3, A.4, B.1, B.3, B.4
DSE_32	Calculate occupant load	A.3, A.4, B.1, B.3, B.4, B.9
DSE_33	Establish points of exit	A.3, A.4, A.8, B.1, B.3, B.4, B.9
DSE_34	Check egress paths for travel distance	A.3, A.4, A.8, B.1, B.3, B.4, B.9
DSE_35	Determine fixture counts.	A.3, A.8, B.3, B.4
DSE_36	Talk about specific parts of my drawings, models, and other visuals	A.1, A.7, A.8, B.1, B.2, B.3, B.4
DSE_37	Clearly explain the details of my drawings, models, and other visuals	A.1, B.2, B.3, B.4, B.9
DSE_38	Respond to questions without being defensive	A.1, A.8
DSE_39	Use my visuals to explain my design concept	A.1, A.4, B.1, B.2, B.4
DSE_40	Explain my design process from start to finish	A.1, A.4, A.8, B.1, B.4, B.8, D.1, D.2, D.3, D.4, D.5
DSE_41	Describe the design problem that was given to me	A.1, A.2, A.4, A.8, B.1, B.2, B.9
DSE_42	Show the connection between my original concept and my final design	A.2, A.3, A.4, B.1
DSE_43	Use design terminology correctly	A.1, A.3, A.4, A.7, B.1, B.2, B.3, B.4, D.1, D.2, D.3, D.4, D.5
DSE_44	Use language that is appropriate for my audience	A.1, A.4, A.7, A.8, B.1, B.2, B.3, B.4, D.1, D.2, D.3, D.4, D.5
DSE_45	Persuade my audience of why my concept is appropriate for the design problem I was given	A.1, A.2, A.4, A.7, A.8, B.1, B**.2,** B.3, B.4, B.5, B.6, B.7, B.8, B.9, D.1, D.2, D.3, D.4, D.5
DSE_46	Make my audience believe I am a credible designer	A.1, A.2, A.3, A.4, A.8, B.1, B.2, B.3, B.4, B.5, B.6, B.7, B.8, B.9, B.10, D.1, D.2, D.3, D.4, D.5
DSE_47	Use professional looking visuals	A.1, A.4, B.1, B.2, B.3, B.4, B.5, B.6, B.7, B.8, B.9
DSE_48	Appear confident	A.1
DSE_49	Reflect on both positives and negatives when responding to questions about my work	A.1, A.2, A.3, A.4
DSE_50	Explain my concept in specific terms	A.1, A.4, B.1, B.2, B.3

Table V.2 Design Self-Efficacy (DSE) Operational Structure Connecting Self-Efficacy to National Architectural Accreditation Board (NAAB) Student Performance Criteria (SPC) for DSE Items 26-50

The NAAB SPCs that are linked to this DSE-M measure are:

- A.3 - Investigative Skills: Ability to gather, assess, record, and comparatively evaluate relevant information and performance in order to support conclusions related to a specific project or assignment,
- A.6 - Use of Precedents: Ability to examine and comprehend the fundamental principles present in relevant precedents and to make informed choices about the incorporation of such principles into architecture and urban design projects,
- A.7 - History and Global Culture: Understanding of the parallel and divergent histories of architecture and the cultural norms of a variety of indigenous, vernacular, local, and regional settings in terms of their political, economic, social, ecological, and technological factors,
- A.8 - Cultural Diversity and Social Equity: Understanding of the diverse needs, values, behavioral norms, physical abilities, and social and spatial patterns that characterize different cultures and individuals and the responsibility of the architect to ensure equity of access to sites, buildings, and structures, and
- C.1 - Research: Understanding of the theoretical and applied research methodologies and practices used during the design process.

Another example would be DSE_18 *I can create technically clear drawings*. In order to create technically clear drawings, a student would need to be able to effectively communicate information to the client, contractor, architect, and faculty, create twodimensional and three-dimensional drawings and models, understand how the drawings address the stated problem, program, site, codes, regulations, and environmental concerns, and ultimately exemplify and determine the assembly of materials, systems, and components appropriate for a building design. The NAAB SPCs that are linked to this DSE-M measure are:

- A.1 - Professional Communication Skills: Ability to write and speak effectively and use representational media appropriate for both within the profession and with the general public,
- A.4 - Architectural Design Skills: Ability to effectively use basic formal, organizational and environmental principles and the capacity of each to inform two- and three-dimensional design,
- B.1 - Pre-Design: Ability to prepare a comprehensive program for an architectural project that includes an assessment of client and user needs; an inventory of spaces and their requirements; an analysis of site conditions (including existing buildings); a review of the relevant building codes and standards, including relevant sustainability requirements, and an assessment of their implications for the project; and a definition of site selection and design assessment criteria,
- B.2 - Site Design: Ability to respond to site characteristics, including urban context and developmental patterning, historical fabric, soil, topography, ecology, climate, and building orientation, in the development of a project design,

- B.4 - Technical Documentation: Ability to make technically clear drawings, prepare outline specifications, and construct models illustrating and identifying the assembly of materials, systems, and components appropriate for a building design,
- B.5 - Structural Systems: Ability to demonstrate the basic principles of structural systems and their ability to withstand gravitational, seismic, and lateral forces, as well as the selection and application of the appropriate structural system,
- B.6 - Environmental Systems: Ability to demonstrate the principles of environmental systems' design, how design criteria can vary by geographic region, and the tools used for performance assessment. This demonstration must include active and passive heating and cooling, solar geometry, daylighting, natural ventilation, indoor air quality, solar systems, lighting systems, and acoustics,
- B.7 - Building Envelope Systems and Assemblies: Understanding of the basic principles involved in the appropriate selection and application of building envelope systems relative to fundamental performance, aesthetics, moisture transfer, durability, and energy and material resources,
- B.8 - Building Materials and Assemblies: Understanding of the basic principles used in the appropriate selection of interior and exterior construction materials, finishes, products, components, and assemblies based on their inherent performance, including environmental impact and reuse,

- B.9 - Building Service Systems: Understanding of the basic principles and appropriate application and performance of building service systems, including lighting, mechanical, plumbing, electrical, communication, vertical transportation, security, and fire protection systems,
- C.1 - Research: Understanding of the theoretical and applied research methodologies and practices used during the design process,
- C.2 - Integrated Evaluations and Decision-Making Design Process: Ability to demonstrate the skills associated with making integrated decisions across multiple systems and variables in the completion of a design project. This demonstration includes problem identification, setting evaluative criteria, analyzing solutions, and predicting the effectiveness of implementation, and
- C.3 - Integrative Design: Ability to make design decisions within a complex architectural project while demonstrating broad integration and consideration of environmental stewardship, technical documentation, accessibility, site conditions, life safety, environmental systems, structural systems, and building envelope systems and assemblies.

This type of SPC to DSE-M coding reflects the tasks that are specific to the domain of architectural design education regardless of the method of working (individually, collectively, or both individually and collectively) or the nature of the project (real or hypothetical). A comprehensive mapping of SPC criteria to DSE-M measures is provided in (Appendix 10).

V.3.2 Self-Efficacy Can Be Measured

Conducting a survey of architecture students tested the Design Self-Efficacy (DSE) instrument (Appendix 09). Based upon the data that was gathered in this project, the instrument has demonstrated sensitivity, which is an underlying condition of establishing internal consistency and reliability. Cronbach's alpha, a commonly employed index of test reliability, was used to measure internal consistency and to measure the DSE scale reliability. Given the large number of items, fifty, it was expected that the Cronbach's alpha score would be high. The Cronbach's alpha for the entire DSE group was $\alpha = .9829$. This value aligns with the multi-dimensionality and consistency of the items that the scale was measuring, but it could also serve as a warning of redundancy. The instrument's construct validity was addressed by comparing the DSE-M task-specific items to theoretical predictors of attainment and the DSE-V, DSE-S, and DSE-P measures of motivation, anxiety, and confidence drawn from self-efficacy literature review and using Bandura's 0 to 100 response format (Bandura, 1997) (Appendix 09).

V.3.2.1 Exploratory Factor Analysis

The results of the Spring 2016 pre-treatment survey DSE test were examined intra- and inter-institutions using a paired t-test. Paired t-tests are typically used in pre- and post-treatment comparison studies, such as this research project. The intent of the paired t-test was used to compare the population means of the institutions involved in the study. An additional analysis on the data was completed to adjust it for missing data and possible non-normality.

Using the pre-treatment survey results as a baseline measurement, the statistical analysis used the pre-treatment survey self-efficacy as independent variables to determine covariance and to compare the results of the post-treatment survey against the baseline self-efficacy. The pre-treatment survey was subtracted from the post-treatment survey to determine the difference or change in DSE. An Analysis of Difference of Means done for each item across the two time points determined whether the change was statistically significant.

It was assumed that students in each of the centers were part of the same population and therefore had the same properties. In an effort to reduce the number of items used in the survey, exploratory factor analysis (EFA), a data reduction technique, was used to group and discriminate measurements. This process was repeated for each institution: TAMU (Table V.3), UKY (Table V.4), and KU (Table V.5). Factor analysis would be able to capture the properties of the common factors, and therefore reveal hidden variables that would confound the study.

Factor loadings were interpreted and then aligned to general headings referring to the SPC criteria. These headings relate to general themes of Design and Communication. The Design factors relate to Research, Iteration, and Evaluation. The Communication factors relate to Graphic Representation and Verbal and Written Exchange. During this step, loadings that were close to zero were ignored. Negative loadings were not included as they often indicate questions that should have been reverse coded. Based on these exploratory interpretations, any potentially ambiguous cross-loadings were resolved in three different ways: first, by assigning the item to a preferred factor, second, by dropping the item, or third, by identifying items that could be reworded in future work.

Using JMP Pro 12.2.0 and (R) software, the data from the centers was analyzed first by each center and then collectively as pooled data. Two processes were used for the study, an Exploratory Factor Analysis (EFA) and a Principal Components Analysis (PCA). This process was conducted both with and without independent factor rotation or Varimax rotation to maximize variance among the squared values of loadings of each factor. This process aided in the interpretation of the data by maximizing the potential number of groupings of elements by determining how strongly each of the items loaded on other factors, thus minimizing the number of elements that were cross-loaded. The results of this process generated a simple structure from which sub-scales to analyze the data were established.

DSE ITEM	DESIGN			COMMUNICATION	
	Design Research	Design Iteration	Design Evaluation	Communicate Graphically	Communicate Verbally
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
DSE_36	0.809	0.255	0.102	0.211	0.056
DSE_45	0.780	0.320	0.236	0.065	0.182
DSE_39	0.767	0.205	0.262	0.289	0.078
DSE_44	0.757	0.246	0.040	0.138	0.216
DSE_41	0.747	0.355	0.167	0.079	0.215
DSE_43	0.745	0.306	0.225	0.237	0.184
DSE_40	0.738	0.110	0.293	0.110	0.059
DSE_37	0.733	0.292	0.334	0.213	0.121
DSE_42	0.719	0.326	0.156	0.163	0.084
DSE_50	0.717	0.342	0.201	0.243	0.201
DSE_46	0.714	0.228	0.308	0.268	0.259
DSE_47	0.693	0.161	0.293	0.343	0.145
DSE_49	0.684	0.299	0.206	0.174	0.152
DSE_38	0.678	0.163	0.163	0.108	-0.030
DSE_48	0.630	0.094	0.331	0.238	0.228
DSE_25	0.541	0.392	0.460	0.116	0.108
DSE_23	0.531	0.270	0.526	0.207	0.200
DSE_16	0.356	0.798	0.137	0.229	0.090
DSE_8	0.270	0.796	0.172	0.133	0.233
DSE_17	0.405	0.748	0.257	0.205	0.097
DSE_9	0.272	0.747	0.284	0.053	0.167
DSE_13	0.297	0.718	0.317	0.156	0.195
DSE_11	0.269	0.714	0.244	0.126	0.256
DSE_10	0.408	0.681	-0.018	0.222	0.134
DSE_7	0.195	0.649	0.342	0.092	0.231
DSE_15	0.220	0.594	0.514	0.209	0.182
DSE_12	0.477	0.528	0.349	-0.061	0.222
DSE_24	0.240	0.334	0.706	0.309	0.083
DSE_22	0.197	0.306	0.689	0.393	0.144
DSE_26	0.282	0.322	0.689	0.248	0.086
DSE_27	0.400	0.305	0.649	0.228	0.145
DSE_24	0.187	0.200	0.648	0.537	0.070
DSE_19	0.267	0.199	0.636	0.340	-0.057
DSE_28	0.244	0.392	0.623	0.317	-0.016
DSE_20	0.250	0.064	0.564	0.402	0.217
DSE_29	0.430	0.202	0.552	0.350	0.236
DSE_5	0.373	0.057	0.512	0.288	0.386
DSE_6	0.274	0.110	0.489	0.339	0.362
DSE_14	0.357	0.445	0.478	0.261	0.212
DSE_34	0.182	0.066	0.259	0.872	0.024
DSE_32	0.159	0.200	0.194	0.862	0.077
DSE_35	0.148	0.215	0.248	0.844	-0.063
DSE_30	0.199	0.159	0.295	0.837	0.114
DSE_31	0.202	0.109	0.246	0.815	0.110
DSE_33	0.336	0.122	0.235	0.775	0.152
DSE_18	0.411	0.078	0.389	0.526	0.228
DSE_2	0.099	0.276	0.146	-0.019	0.772
DSE_3	0.307	0.384	0.095	0.202	0.671
DSE_4	0.247	0.435	0.000	0.133	0.657
DSE_1	0.338	0.213	0.375	0.108	0.629

Table V.3 TAMU Exploratory Factor Analysis Pre-Treatment Survey Design and Communication Factors

DSE ITEM	DESIGN			COMMUNICATION	
	Design Research	Design Iteration	Design Evaluation	Communicate Graphically	Communicate Verbally
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
DSE_7	0.867	0.124	0.137	0.072	0.021
DSE_9	0.824	0.239	0.301	0.110	-0.090
DSE_10	0.820	0.304	0.303	0.063	-0.040
DSE_17	0.792	0.273	0.315	0.272	0.139
DSE_23	0.769	0.123	0.156	0.201	0.149
DSE_11	0.760	0.131	0.310	0.144	-0.169
DSE_3	0.751	0.359	0.064	0.069	0.176
DSE_8	0.739	0.229	0.453	0.096	-0.030
DSE_16	0.726	0.385	0.261	0.246	0.181
DSE_13	0.712	0.198	0.435	0.338	0.114
DSE_15	0.699	0.331	0.265	0.364	0.162
DSE_41	0.693	0.462	0.305	0.150	0.139
DSE_25	0.665	0.347	0.430	0.349	0.137
DSE_14	0.664	0.357	0.308	0.396	0.067
DSE_50	0.627	0.610	0.290	0.049	0.182
DSE_43	0.625	0.555	0.252	0.080	0.236
DSE_45	0.618	0.599	0.240	0.167	0.035
DSE_29	0.602	0.342	0.521	0.327	0.084
DSE_12	0.595	0.330	0.319	0.058	-0.123
DSE_26	0.572	0.304	0.338	0.410	0.147
DSE_28	0.564	0.373	0.459	0.368	0.232
DSE_37	0.308	0.782	0.210	0.225	-0.091
DSE_36	0.267	0.771	0.299	0.281	0.083
DSE_49	0.248	0.756	0.306	0.207	0.213
DSE_42	0.473	0.747	0.153	0.172	-0.041
DSE_46	0.302	0.738	0.309	0.275	-0.027
DSE_48	-0.094	0.732	0.311	0.099	0.154
DSE_47	0.400	0.722	0.239	0.068	0.027
DSE_44	0.371	0.660	0.379	0.285	0.150
DSE_39	0.631	0.656	0.178	0.104	0.001
DSE_40	0.498	0.628	0.017	-0.120	0.041
DSE_38	0.107	0.549	-0.029	0.442	0.292
DSE_1	0.458	0.547	0.248	-0.075	0.275
DSE_5	0.222	0.547	-0.001	0.402	-0.314
DSE_30	0.182	0.237	0.858	0.120	0.087
DSE_34	0.345	0.138	0.833	0.189	-0.006
DSE_31	0.259	0.247	0.826	0.137	0.048
DSE_32	0.369	0.198	0.769	0.041	-0.026
DSE_33	0.243	0.340	0.721	0.234	0.100
DSE_35	0.371	0.252	0.697	0.095	0.101
DSE_27	0.519	0.255	0.525	0.434	0.007
DSE_18	0.041	0.389	0.097	0.782	0.020
DSE_6	0.067	0.054	0.088	0.782	0.060
DSE_21	0.418	0.154	0.511	0.552	-0.107
DSE_20	0.259	0.087	0.358	0.540	-0.535
DSE_19	0.414	-0.007	0.335	0.511	0.147
DSE_22	0.449	0.360	0.370	0.486	0.123
DSE_24	0.358	0.403	0.395	0.472	-0.059
DSE_4	0.392	0.207	0.138	0.390	0.679
DSE_2	0.204	0.403	0.413	0.044	0.578

Table V.4 UKY Exploratory Factor Analysis Pre-Treatment Survey Design and Communication Factors

DSE ITEM	DESIGN			COMMUNICATION	
	Design Research	Design Iteration	Design Evaluation	Communicate Verbally	Communicate Visually
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
DSE_9	0.861	0.071	-0.061	0.060	0.130
DSE_11	0.859	0.169	0.091	0.163	0.226
DSE_10	0.829	0.063	-0.162	0.195	0.076
DSE_16	0.813	0.209	0.300	-0.006	0.050
DSE_8	0.809	0.153	0.184	-0.158	0.153
DSE_17	0.793	0.279	0.076	0.033	0.118
DSE_7	0.792	0.239	0.298	0.045	0.152
DSE_13	0.684	0.203	0.331	0.034	0.269
DSE_44	0.641	0.446	0.158	0.203	-0.068
DSE_14	0.629	0.109	0.212	0.247	0.366
DSE_38	0.613	0.111	0.073	0.442	-0.046
DSE_42	0.592	0.332	0.120	0.068	-0.159
DSE_45	0.541	0.519	0.163	0.356	-0.064
DSE_12	0.489	0.124	-0.012	0.063	-0.030
DSE_15	0.350	0.280	0.347	0.201	0.292
DSE_36	0.190	0.896	0.216	-0.018	0.037
DSE_37	0.090	0.870	-0.016	0.119	0.069
DSE_1	0.226	0.720	0.021	0.187	0.070
DSE_41	0.475	0.676	0.132	0.155	-0.004
DSE_40	0.426	0.663	-0.069	0.086	-0.036
DSE_39	0.520	0.637	0.152	0.091	0.207
DSE_48	0.011	0.593	-0.111	0.368	0.121
DSE_46	0.091	0.565	-0.017	0.070	0.464
DSE_23	0.297	0.562	0.142	0.022	0.211
DSE_27	0.278	0.538	0.456	0.143	0.277
DSE_47	0.178	0.531	0.118	-0.069	0.508
DSE_50	0.366	0.522	0.023	0.382	0.003
DSE_43	0.426	0.508	0.496	0.222	-0.092
DSE_29	0.428	0.465	0.285	0.259	0.178
DSE_30	0.029	0.168	0.905	0.039	0.063
DSE_32	0.147	0.107	0.874	0.065	0.014
DSE_35	0.055	-0.072	0.841	0.050	0.170
DSE_34	0.127	-0.026	0.836	0.068	0.128
DSE_33	0.189	0.074	0.805	0.083	0.085
DSE_31	-0.007	0.034	0.799	0.081	0.091
DSE_28	0.314	0.072	-0.094	0.706	0.142
DSE_4	-0.076	0.148	0.071	0.650	-0.042
DSE_24	0.245	0.014	0.200	0.623	0.173
DSE_26	0.038	0.198	0.008	0.606	0.414
DSE_3	0.492	0.141	0.011	0.569	-0.088
DSE_49	0.523	0.059	-0.003	0.553	0.013
DSE_2	-0.082	0.451	-0.057	0.524	0.092
DSE_25	0.063	0.062	0.207	0.488	0.012
DSE_18	-0.051	0.277	0.250	0.460	0.391
DSE_20	-0.065	0.197	0.018	0.121	0.848
DSE_21	0.032	0.376	0.129	0.129	0.673
DSE_19	-0.004	-0.261	0.112	0.334	0.671
DSE_22	0.347	-0.104	0.148	0.029	0.652
DSE_5	0.443	0.153	0.398	-0.160	0.562
DSE_6	0.265	0.313	0.262	-0.078	0.425

Table V.5 KU Exploratory Factor Analysis Pre-Treatment Survey Design and Communication Factors

It was assumed that if the center datasets had common covariance (variance in a variable that is shared with other variables) then the data could be pooled together and treated as a dataset. Further, it would then be possible for the fifty items to be expressed as five factors that, in turn, summarize and explain the amount of variance across the dataset. The factor analysis created eigenvalues that represent the variance in the variables that is accounted for by a specific factor. The methods of combining the scores could be studied in two ways: first, by assuming equal value for each self-reported score and second, by using the rotated factor loadings as a multiplier for each score and those numbers added together and a mean taken.

V.3.2.2 Analysis of Covariance

For this study, the seventy students who answered both pre-treatment and post-treatment surveys are included in this analysis. After the data was collected at the two time points, the data was examined to identify its completeness (number of students who responded to each of the 50 survey questions). It was determined that several of the student responses contained missing data. The percentage of missing values ranged from 0-15% (Figure V.1 and Figure V.2).

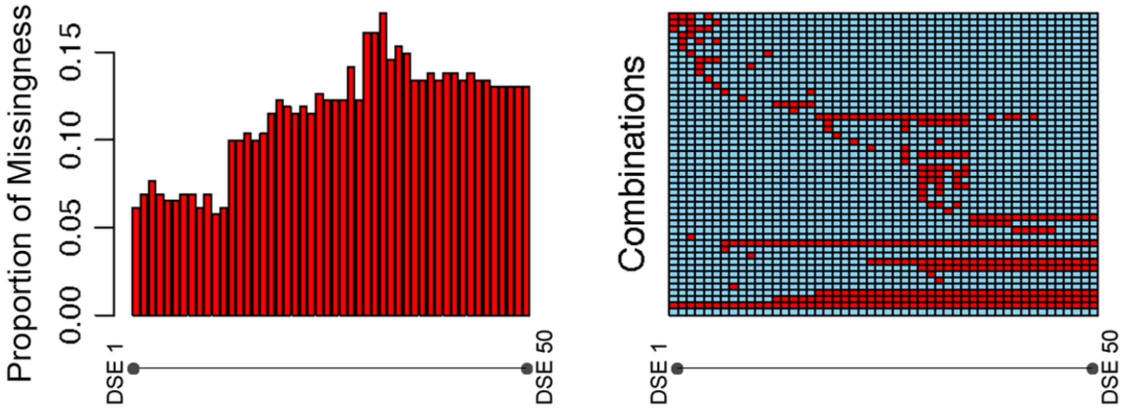

Figure V.1 Proportion of Missingness Pre-Treatment Survey

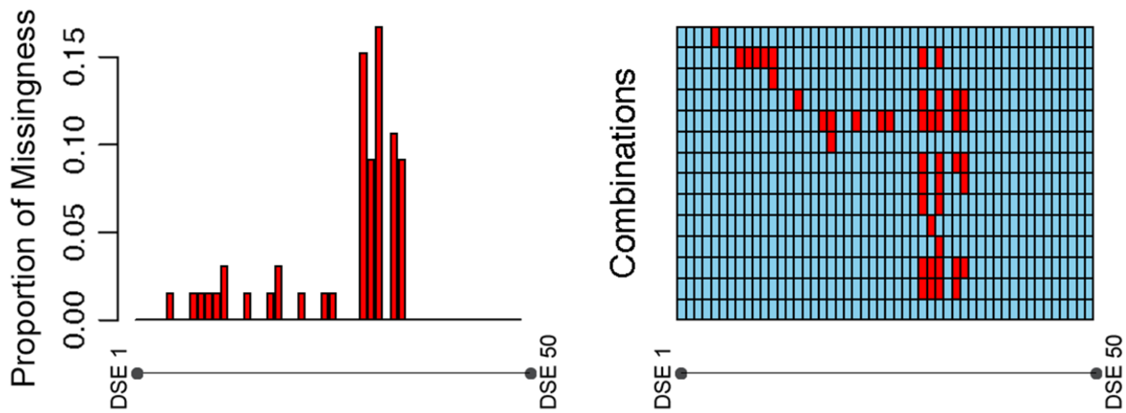

Figure V.2 Proportion of Missingness Post-Treatment Survey

Rather than imputing values for the missing data during this phase, as it could have varied the results, a decision was made to only use complete survey data. A homogeneity test about covariance to DSE measures was performed to see if the center populations of TAMU, UKY, and KU share a common covariance matrix. The hypothesis tested was $H0 : \Sigma 1 = \Sigma 2 = \Sigma 3$ and $Ha : \Sigma i = \Sigma j$ for at least one pair (i, j), i /= j.

This analysis used the test statistics T 2 to test the equality of several covariance matrices with fewer observations than the dimension included in the survey (Srivastava and Yanagihara, 2010). The result of the homogeneity test rejected the null hypothesis: T 2 = 11.0632 with a p-value = 0.004036. Therefore, the three institutions: TAMU, UKY, and KU have different covariance matrix for DSE measures and demonstrate that the covariance was not equal and therefore the centers could not be pooled as one dataset.

V.3.2.3 Factor Analysis

As noted above, the exploratory factor analysis revealed that the centers could not be pooled together and treated as one population. However, a visual examination of the scree plot revealed some common elements, and therefore, each center was analyzed separately using factor analysis (Figure V.3). The intent of the factor analysis was twofold: as a data reduction technique that maintains the coherence of the data and to reveal trends that could possibly reduce the DSE data from fifty items to a smaller number. Since the covariance test showed that the structure of the data between centers is different, it is logical that the factor analysis would also be different. Established statistical criteria of explaining at least 80% of the variance in the original data led to the following data explanation. For this study, a .50 loading factor was used as a cutoff to assign groups to DSE items per factor. TAMU requires eleven factors (Table V.6), UKY requires ten factors (Table V.7), and KU requires fourteen factors (Table V.8). The results of the factor analysis on the students who completed the pre-treatment survey and post-treatment survey did not lead to the desired reduction and proved to be not interpretable across the centers, therefore an priori set of categories was used instead.

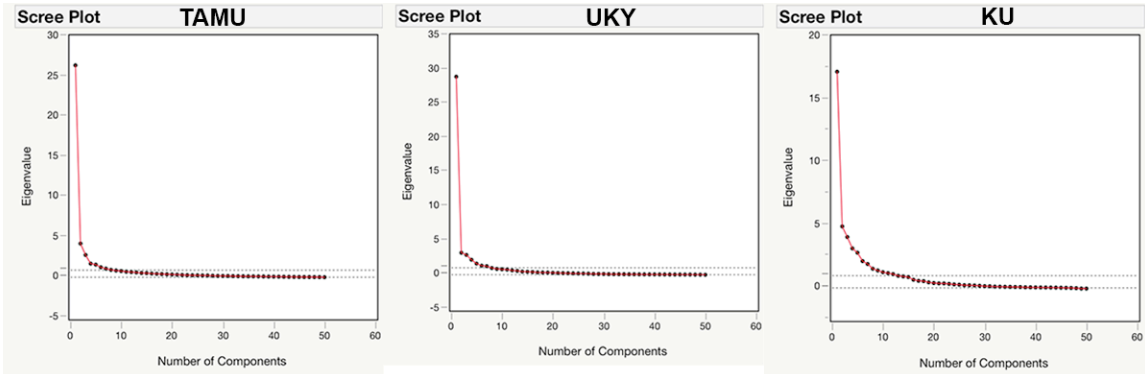

Figure V.3 Scree Plots from TAMU, UKY, and KU Pre-Treatment Survey Factor Analysis

DSE ITEM	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Factor11
DSE1	0.311	0.213	0.257	0.190	0.240	0.162	0.049	0.804	0.088	0.072	0.059
DSE2	0.108	0.051	0.287	0.043	0.499	0.116	0.078	0.429	0.093	0.027	0.058
DSE3	0.307	0.198	0.336	0.087	0.656	0.066	0.061	0.279	0.058	0.032	-0.002
DSE4	0.279	0.110	0.322	0.086	0.881	0.039	0.046	0.024	-0.022	-0.002	0.015
DSE5	0.316	0.341	0.174	0.227	0.066	0.544	0.172	0.333	0.020	0.079	0.017
DSE6	0.215	0.380	0.217	0.189	0.102	0.803	0.172	0.098	0.099	0.012	0.053
DSE7	0.208	0.159	0.681	0.204	0.117	0.166	0.111	0.136	0.039	0.071	0.084
DSE8	0.284	0.199	0.815	0.099	0.137	0.079	0.022	0.134	0.033	0.022	0.029
DSE9	0.283	0.141	0.765	0.197	0.103	0.143	0.052	0.103	0.079	0.045	0.001
DSE10	0.381	0.210	0.625	0.004	0.226	0.026	0.065	-0.067	0.107	-0.013	0.099
DSE11	0.285	0.205	0.717	0.190	0.174	0.133	0.039	0.074	-0.010	0.141	0.052
DSE12	0.465	0.048	0.516	0.261	0.188	0.093	0.018	0.117	0.051	0.190	0.060
DSE13	0.311	0.199	0.694	0.224	0.199	0.092	0.211	0.046	0.084	0.031	-0.025
DSE14	0.348	0.304	0.441	0.299	0.159	0.099	0.342	0.122	0.126	0.062	-0.006
DSE15	0.231	0.288	0.559	0.349	0.170	0.062	0.223	0.108	0.057	0.096	0.052
DSE16	0.385	0.239	0.749	0.161	0.144	-0.070	0.051	0.041	0.055	-0.082	-0.017
DSE17	0.413	0.237	0.727	0.210	0.097	0.024	0.048	0.098	0.047	0.009	0.017
DSE18	0.364	0.541	0.083	0.244	0.267	0.145	0.277	0.011	0.129	0.043	0.072
DSE19	0.248	0.381	0.213	0.599	0.034	0.150	0.243	0.021	0.082	-0.081	0.094
DSE20	0.205	0.424	0.162	0.243	0.089	0.261	0.688	0.052	0.008	0.056	0.080
DSE21	0.165	0.596	0.217	0.475	0.077	0.085	0.323	0.107	0.094	0.035	-0.012
DSE22	0.199	0.464	0.309	0.602	0.135	0.090	0.254	0.108	0.065	0.023	0.021
DSE23	0.473	0.315	0.324	0.239	0.079	0.141	0.404	0.121	0.106	0.258	0.094
DSE24	0.289	0.433	0.319	0.646	0.049	0.155	0.050	0.108	0.038	0.129	0.039
DSE25	0.507	0.232	0.409	0.373	0.104	0.175	0.015	0.061	0.109	0.209	0.090

Table V.6a. TAMU Summary of Factor Analysis Pre-Treatment and Post-Treatment Survey for DSE Items 1-25 (Assumes .50 Weight Significance)

DSE ITEM	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Factor11
DSE26	0.273	0.349	0.306	0.624	0.114	0.156	0.027	0.090	0.088	0.129	0.096
DSE27	0.375	0.366	0.333	0.401	0.024	0.089	0.218	0.209	0.114	0.569	-0.027
DSE28	0.298	0.429	0.382	0.666	0.036	0.013	0.033	0.094	0.047	0.012	-0.035
DSE29	0.408	0.430	0.267	0.360	0.121	0.286	0.214	0.107	-0.029	0.146	0.068
DSE30	0.193	0.873	0.179	0.160	0.066	0.076	0.072	0.159	0.086	0.032	-0.065
DSE31	0.194	0.814	0.132	0.122	0.077	0.066	0.175	0.010	0.014	0.085	0.092
DSE32	0.157	0.884	0.230	0.116	0.043	0.064	0.012	0.144	0.026	-0.036	0.014
DSE33	0.321	0.794	0.121	0.101	0.131	0.186	0.107	-0.036	0.005	0.101	0.089
DSE34	0.180	0.880	0.122	0.184	0.051	0.056	0.066	0.056	0.083	0.019	0.057
DSE35	0.150	0.860	0.207	0.219	0.017	0.100	-0.023	-0.009	0.054	0.015	-0.010
DSE36	0.703	0.236	0.305	0.036	0.067	0.087	0.053	0.053	0.436	0.013	0.051
DSE37	0.652	0.279	0.349	0.188	0.048	0.140	0.117	0.116	0.391	0.000	0.096
DSE38	0.600	0.110	0.211	0.137	0.073	0.116	0.178	-0.145	0.077	-0.061	0.205
DSE39	0.668	0.311	0.264	0.141	0.069	0.148	0.163	0.086	0.359	0.001	0.073
DSE40	0.616	0.185	0.138	0.201	0.033	0.087	0.021	0.139	0.678	0.080	-0.020
DSE41	0.767	0.148	0.324	0.143	0.181	0.115	0.010	0.064	-0.016	0.094	-0.079
DSE42	0.672	0.214	0.294	0.130	0.106	0.031	0.104	0.035	0.170	0.054	-0.045
DSE43	0.787	0.305	0.294	0.183	0.117	0.069	0.068	0.164	0.050	-0.024	-0.189
DSE44	0.795	0.157	0.232	0.080	0.194	0.078	0.013	0.089	-0.034	-0.006	-0.051
DSE45	0.815	0.140	0.310	0.199	0.117	-0.001	0.079	0.162	0.026	0.088	-0.023
DSE46	0.692	0.314	0.255	0.208	0.147	0.136	0.100	0.168	0.034	0.048	0.210
DSE47	0.685	0.323	0.203	0.183	0.073	0.202	0.159	0.022	-0.001	0.027	0.181
DSE48	0.596	0.242	0.173	0.197	0.060	0.124	0.170	0.186	0.025	-0.001	0.559
DSE49	0.689	0.194	0.296	0.147	0.135	0.041	0.138	0.052	-0.066	0.139	0.131
DSE50	0.698	0.282	0.354	0.191	0.164	0.052	-0.015	0.153	0.131	0.091	0.082

Table V.6b. TAMU Summary of Factor Analysis Pre-Treatment and Post-Treatment Survey for DSE Items 26-50 (Assumes .50 Weight Significance)

DES ITEM	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10
DSE1	0.391	0.409	0.218	0.532	-0.125	0.218	-0.018	0.096	-0.108	0.119
DSE2	0.176	0.350	0.303	0.812	0.104	0.151	0.109	-0.082	0.077	-0.051
DSE3	0.631	0.199	0.137	0.190	0.037	0.339	0.051	-0.043	-0.024	0.198
DSE4	0.467	0.234	0.126	0.466	0.257	-0.084	0.185	-0.199	0.215	-0.055
DSE5	0.282	0.330	0.072	-0.036	0.156	0.065	0.089	0.108	0.040	0.743
DSE6	0.095	0.092	0.153	0.061	0.836	0.036	0.076	0.162	0.153	0.102
DSE7	0.793	0.066	0.161	0.118	0.049	0.170	0.021	-0.033	0.078	0.266
DSE8	0.778	0.198	0.371	0.215	-0.019	0.076	-0.045	0.241	0.042	0.140
DSE9	0.805	0.242	0.260	0.025	-0.030	0.129	0.154	0.158	0.064	0.116
DSE10	0.848	0.227	0.276	0.080	0.019	0.188	0.091	0.026	0.009	0.169
DSE11	0.748	0.173	0.227	-0.031	-0.068	0.011	0.224	0.179	0.258	0.072
DSE12	0.587	0.328	0.158	0.193	0.002	0.024	0.319	0.291	-0.028	0.051
DSE13	0.738	0.259	0.411	0.093	0.109	-0.012	0.080	0.064	0.203	0.079
DSE14	0.699	0.392	0.297	0.056	0.152	0.008	0.219	0.125	0.028	0.019
DSE15	0.714	0.423	0.255	0.039	0.226	-0.030	0.059	0.043	0.162	-0.026
DSE16	0.765	0.391	0.261	0.088	0.213	0.075	0.003	-0.039	0.042	0.039
DSE17	0.811	0.277	0.321	0.083	0.124	0.125	0.073	0.026	0.149	-0.007
DSE18	0.060	0.343	0.222	0.068	0.429	-0.012	0.064	0.181	0.067	0.283
DSE19	0.365	0.138	0.282	0.070	0.239	-0.012	0.032	0.083	0.785	0.041
DSE20	0.250	0.122	0.285	-0.109	0.349	-0.022	0.134	0.778	0.102	0.125
DSE21	0.363	0.145	0.522	0.084	0.255	0.119	0.155	0.258	0.329	0.283
DSE22	0.448	0.349	0.332	0.291	0.368	0.003	0.243	0.185	0.024	0.093
DSE23	0.658	0.136	0.164	0.117	0.172	0.171	0.035	0.063	0.243	-0.020
DSE24	0.336	0.362	0.335	0.184	0.198	0.069	0.636	0.187	0.066	0.193
DSE25	0.646	0.370	0.372	0.178	0.209	0.079	0.214	0.146	0.152	0.045

Table V.7a. UKY Summary of Factor Analysis Pre-Treatment and Post-Treatment Survey for DSE Items 1-25 (Assumes .50 Weight Significance)

DES ITEM	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10
DSE26	0.567	0.283	0.333	0.146	0.284	0.135	0.435	0.055	-0.022	-0.076
DSE27	0.514	0.254	0.502	0.070	0.162	0.117	0.351	0.128	0.174	0.044
DSE28	0.581	0.383	0.422	0.272	0.142	-0.031	0.247	-0.007	0.177	0.157
DSE29	0.600	0.323	0.538	0.097	0.161	0.109	0.177	0.010	0.088	0.153
DSE30	0.208	0.262	0.812	0.202	0.000	-0.039	0.141	0.095	0.135	0.016
DSE31	0.294	0.289	0.835	0.094	0.026	-0.025	-0.007	0.068	0.064	0.042
DSE32	0.348	0.167	0.751	0.108	0.257	0.235	0.074	0.126	-0.019	-0.065
DSE33	0.263	0.359	0.762	0.057	0.046	0.093	0.053	0.018	0.108	0.037
DSE34	0.375	0.176	0.820	0.088	0.147	-0.062	0.117	0.058	0.051	0.085
DSE35	0.324	0.206	0.720	0.143	0.028	0.208	0.021	0.065	0.096	0.060
DSE36	0.297	0.795	0.269	0.155	0.052	0.083	0.001	0.172	0.012	0.083
DSE37	0.269	0.713	0.182	0.050	0.032	0.295	0.321	0.160	0.080	0.156
DSE38	0.167	0.580	0.065	0.025	0.080	0.008	0.120	-0.138	0.174	0.005
DSE39	0.619	0.572	0.197	0.087	0.070	0.259	0.035	-0.019	-0.041	0.208
DSE40	0.359	0.429	0.050	0.143	0.030	0.801	0.076	-0.016	-0.009	0.067
DSE41	0.691	0.475	0.231	0.209	0.077	0.097	0.002	0.060	0.143	0.065
DSE42	0.450	0.666	0.160	0.093	0.007	0.271	-0.051	0.114	0.019	0.263
DSE43	0.577	0.520	0.292	0.130	0.178	0.316	-0.050	-0.131	0.057	0.006
DSE44	0.390	0.728	0.333	0.079	0.068	0.053	0.111	0.044	0.177	0.012
DSE45	0.600	0.560	0.176	0.152	0.063	0.251	0.199	0.115	0.115	0.046
DSE46	0.330	0.783	0.223	0.033	0.128	0.056	0.281	0.070	0.099	0.139
DSE47	0.373	0.691	0.235	0.057	0.041	0.120	-0.008	0.004	-0.017	0.205
DSE48	0.012	0.751	0.200	0.278	0.095	-0.009	0.008	0.092	0.010	-0.016
DSE49	0.319	0.746	0.266	0.237	0.083	0.093	0.098	-0.089	0.031	0.093
DSE50	0.585	0.525	0.264	0.254	0.098	0.390	-0.003	0.010	0.032	0.043

Table V.7b. UKY Summary of Factor Analysis Pre-Treatment and Post-Treatment Survey for DSE Items 26-50 (Assumes .50 Weight Significance)

DSE ITEM	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Factor11	Factor12	Factor13	Factor14
DSE1	0.309	-0.011	0.515	0.108	0.043	0.086	0.566	-0.124	0.131	0.090	-0.032	-0.057	0.057	0.314
DSE2	0.044	-0.076	0.222	0.062	0.039	0.070	0.848	0.132	0.053	0.068	0.238	0.108	0.046	0.034
DSE3	0.436	-0.039	0.077	-0.051	0.248	0.030	0.333	0.218	0.146	-0.036	0.145	-0.008	0.058	-0.002
DSE4	0.021	0.074	0.003	0.061	0.145	0.025	0.187	0.096	0.125	0.008	0.886	0.090	0.058	0.118
DSE5	0.376	0.417	0.085	0.360	0.096	0.324	-0.069	0.003	-0.041	0.053	-0.244	0.346	0.025	0.036
DSE6	0.307	0.257	0.103	0.226	-0.040	0.159	0.147	-0.048	-0.008	0.045	0.141	0.828	0.040	0.003
DSE7	0.832	0.241	0.212	0.130	0.047	-0.010	0.071	0.039	-0.067	0.071	0.096	0.053	0.113	-0.175
DSE8	0.880	0.123	0.083	-0.012	0.024	0.104	-0.009	0.056	0.020	0.058	-0.111	0.114	-0.174	0.168
DSE9	0.832	-0.072	0.043	0.040	0.250	0.008	-0.018	-0.064	0.017	0.064	-0.092	0.062	0.065	0.111
DSE10	0.725	-0.150	0.143	0.068	0.476	-0.055	-0.001	-0.033	0.041	-0.054	0.015	0.057	0.102	0.039
DSE11	0.845	0.059	0.129	0.154	0.207	0.141	0.041	0.015	0.158	0.023	0.053	0.038	0.057	-0.028
DSE12	0.357	-0.046	0.129	-0.069	0.058	0.013	0.075	-0.036	0.100	0.039	0.021	0.037	0.019	-0.039
DSE13	0.744	0.272	0.212	0.201	-0.023	0.106	0.045	0.136	0.037	-0.096	0.028	0.010	-0.117	-0.094
DSE14	0.592	0.199	0.007	0.170	0.112	0.253	0.125	0.320	0.347	0.258	-0.084	0.080	0.117	0.032
DSE15	0.348	0.359	0.300	0.216	0.123	0.057	0.064	0.131	-0.072	0.074	0.018	-0.106	0.068	0.120
DSE16	0.844	0.251	0.166	-0.086	0.035	0.066	0.097	0.128	-0.024	0.009	-0.028	0.074	0.002	0.108
DSE17	0.771	0.048	0.237	0.027	0.082	0.071	-0.004	-0.013	-0.058	0.241	0.048	-0.022	0.278	-0.089
DSE18	0.013	0.258	0.164	0.434	0.070	-0.005	0.323	0.085	0.027	-0.093	0.292	0.255	0.066	-0.017
DSE19	0.015	0.153	-0.229	0.603	0.138	0.159	0.042	0.269	-0.080	-0.262	0.101	-0.084	0.200	-0.090
DSE20	-0.010	0.020	0.121	0.879	0.024	0.284	0.025	0.120	-0.018	-0.080	0.101	0.080	-0.154	-0.023
DSE21	0.071	0.125	0.237	0.742	-0.085	0.041	-0.021	0.062	0.067	0.358	0.039	0.077	0.180	0.139
DSE22	0.329	0.167	-0.148	0.620	0.057	0.005	0.087	0.004	0.134	0.211	-0.164	0.115	0.020	0.021
DSE23	0.293	0.087	0.397	0.204	0.001	0.039	0.110	0.114	0.039	0.813	0.001	0.036	-0.011	0.004
DSE24	0.205	0.155	0.041	0.149	0.151	-0.002	0.074	0.902	0.163	0.064	0.101	-0.053	-0.022	0.029
DSE25	0.040	0.149	0.131	0.036	0.004	-0.026	0.045	0.160	0.946	0.040	0.106	-0.022	0.051	-0.010

Table V.8a. KU Summary of Factor Analysis Pre-Treatment and Post-Treatment Survey for DSE Items 1-25 (Assumes .50 Weight Significance)

DSE ITEM	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Factor11	Factor12	Factor13	Factor14
DSE26	-0.029	0.034	0.253	0.314	0.185	0.121	0.049	0.557	0.187	0.071	0.055	0.054	0.361	0.096
DSE27	0.355	0.383	0.471	0.312	-0.162	0.027	0.139	0.008	0.259	0.281	0.096	0.052	0.046	-0.099
DSE28	0.198	-0.058	0.075	0.103	0.310	0.038	0.134	0.188	0.523	-0.048	0.131	0.098	0.625	0.040
DSE29	0.477	0.235	0.500	0.256	0.012	-0.134	0.054	0.140	0.101	0.151	0.273	0.088	-0.003	-0.031
DSE30	0.019	0.938	0.160	0.074	0.053	-0.028	0.011	-0.007	-0.039	0.177	-0.011	0.017	0.037	0.028
DSE31	0.017	0.748	-0.015	0.018	0.031	0.072	-0.157	0.063	0.099	0.044	0.126	0.356	-0.060	0.078
DSE32	0.155	0.893	0.042	-0.025	0.166	0.067	0.085	0.060	-0.002	0.087	0.053	0.090	-0.175	0.093
DSE33	0.218	0.805	0.128	0.113	-0.066	-0.021	0.029	-0.001	0.036	-0.059	0.007	-0.073	0.272	-0.154
DSE34	0.163	0.813	0.050	0.122	-0.097	-0.039	-0.241	0.102	0.139	0.001	-0.014	-0.085	0.136	0.052
DSE35	0.089	0.826	-0.096	0.098	0.030	0.145	0.136	0.042	0.031	-0.156	-0.003	0.065	-0.149	-0.159
DSE36	0.235	0.186	0.864	0.085	-0.072	0.131	0.154	0.034	-0.008	0.102	-0.056	0.014	-0.048	0.129
DSE37	0.092	0.010	0.870	0.028	0.099	0.211	0.211	0.072	0.085	0.094	-0.039	0.010	0.009	0.132
DSE38	0.446	0.101	0.169	0.066	0.716	0.029	0.022	0.113	0.051	-0.082	0.200	-0.051	-0.106	-0.071
DSE39	0.518	0.125	0.622	0.064	0.127	0.392	0.014	0.080	0.099	-0.039	0.099	0.125	-0.006	-0.044
DSE40	0.312	-0.050	0.738	-0.062	0.320	0.125	-0.047	-0.003	0.034	0.099	0.023	0.100	0.132	-0.002
DSE41	0.477	0.074	0.580	0.041	0.078	0.178	0.064	0.043	-0.006	0.102	0.098	-0.036	0.145	0.018
DSE42	0.441	0.077	0.413	-0.131	0.380	0.021	-0.091	0.105	0.116	0.295	0.108	0.064	-0.141	-0.233
DSE43	0.480	0.432	0.324	-0.046	0.146	0.127	0.125	0.120	0.014	0.208	0.152	-0.111	-0.116	0.220
DSE44	0.652	0.121	0.269	-0.050	0.172	0.115	0.134	0.018	0.056	0.244	0.259	0.025	-0.005	0.174
DSE45	0.476	0.136	0.464	-0.027	0.234	0.211	0.024	0.140	0.161	0.093	0.128	-0.153	0.177	0.084
DSE46	0.173	0.033	0.314	0.227	-0.024	0.752	0.142	0.061	-0.041	0.034	0.050	-0.005	0.032	0.121
DSE47	0.192	0.147	0.332	0.258	0.104	0.790	-0.021	-0.006	0.031	0.017	-0.021	0.211	0.019	0.097
DSE48	0.074	-0.062	0.385	0.073	0.183	0.294	0.160	0.122	-0.013	0.002	0.274	0.029	0.029	0.711
DSE49	0.296	0.080	0.083	0.033	0.845	0.049	0.057	0.188	0.027	0.033	0.032	0.008	0.205	0.195
DSE50	0.306	0.085	0.373	-0.012	0.421	0.248	0.200	0.031	-0.183	0.239	0.130	-0.158	0.327	0.045

Table V.8b. KU Summary of Factor Analysis Pre-Treatment and Post-Treatment Survey for DSE Items 26-50 (Assumes .50 Weight Significance)

V.3.2.4 Principal Components

The PCA model (EM Algorithm) was used to impute the missing values in the dataset from all three centers. From the scree-plot of PCA, if nine Principal Components are included, over 80% of the variation of DSE-M is covered. The variances for each component and the cumulative variance for each component are shown for TAMU (Table V.9), UKY (Table V.10), and KU (Table V.11).

DSE ITEM	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
DSE1	-0.118	-0.100	-0.065	-0.040	-0.324	0.422	-0.105	0.014	-0.055	0.110
DSE2	-0.064	-0.104	-0.151	-0.163	-0.383	0.169	-0.009	0.083	-0.009	0.383
DSE3	-0.109	-0.121	-0.065	-0.235	-0.343	0.043	0.241	-0.177	0.012	-0.084
DSE4	-0.092	-0.138	-0.098	-0.253	-0.334	-0.155	0.377	-0.187	0.060	0.013
DSE5	-0.125	-0.015	0.005	0.167	-0.242	0.152	-0.359	-0.202	-0.117	-0.217
DSE6	-0.107	0.011	-0.027	0.123	-0.191	0.008	-0.297	-0.062	-0.176	-0.045
DSE7	-0.082	-0.086	-0.165	-0.070	0.043	0.011	-0.146	0.013	-0.082	0.043
DSE8	-0.115	-0.133	-0.168	-0.228	0.096	-0.045	-0.234	0.007	-0.012	-0.037
DSE9	-0.100	-0.125	-0.165	-0.131	0.116	0.016	-0.212	-0.030	-0.052	-0.025
DSE10	-0.104	-0.118	-0.027	-0.207	0.104	-0.233	-0.018	-0.120	-0.175	-0.083
DSE11	-0.103	-0.109	-0.152	-0.147	0.056	-0.026	-0.160	-0.061	0.047	-0.099
DSE12	-0.102	-0.170	-0.080	-0.020	0.041	0.048	-0.040	-0.008	0.050	-0.257
DSE13	-0.114	-0.117	-0.179	-0.095	0.065	-0.163	0.014	0.101	-0.109	0.099
DSE14	-0.128	-0.072	-0.114	0.043	-0.024	-0.117	0.016	0.231	-0.076	0.081
DSE15	-0.136	-0.083	-0.240	0.002	0.030	-0.130	0.048	0.160	-0.012	-0.088
DSE16	-0.127	-0.133	-0.136	-0.211	0.189	-0.173	-0.001	-0.029	-0.075	0.129
DSE17	-0.121	-0.124	-0.115	-0.115	0.153	-0.094	-0.054	-0.012	-0.096	-0.034
DSE18	-0.155	0.046	0.084	0.133	-0.192	-0.181	0.312	-0.024	-0.205	-0.316
DSE19	-0.151	0.026	-0.144	0.321	0.139	-0.064	0.166	-0.394	-0.150	0.354
DSE20	-0.133	0.043	-0.071	0.272	-0.220	-0.310	-0.130	0.093	-0.176	0.094
DSE21	-0.174	0.107	-0.164	0.228	-0.011	-0.026	0.196	0.025	-0.192	-0.215
DSE22	-0.165	0.026	-0.241	0.189	-0.002	0.038	0.152	-0.008	0.108	0.166
DSE23	-0.130	-0.075	-0.007	0.121	-0.062	-0.097	-0.088	0.274	-0.003	0.059
DSE24	-0.155	0.000	-0.174	0.170	0.108	0.129	0.033	-0.016	0.243	0.124
DSE25	-0.125	-0.111	-0.009	0.064	0.084	0.055	0.063	0.001	0.071	-0.130

Table V.9a TAMU Principal Component Analysis for DSE Items 1-25

DSE ITEM	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
DSE26	-0.147	-0.031	-0.179	0.184	0.083	0.159	0.108	-0.096	0.181	-0.173
DSE27	-0.152	-0.053	-0.088	0.152	0.019	0.136	-0.041	0.318	0.135	-0.149
DSE28	-0.151	-0.006	-0.169	0.100	0.196	0.148	0.099	-0.003	0.210	0.100
DSE29	-0.130	-0.019	-0.012	0.111	-0.078	-0.022	-0.099	0.042	0.163	-0.170
DSE30	-0.242	0.287	0.021	-0.128	-0.045	0.122	0.055	0.142	-0.147	-0.132
DSE31	-0.211	0.276	0.089	-0.072	-0.095	-0.246	-0.085	0.259	0.255	0.177
DSE32	-0.235	0.312	0.021	-0.251	0.029	0.121	-0.164	-0.058	-0.037	0.024
DSE33	-0.208	0.204	0.165	-0.062	-0.117	-0.228	0.005	0.155	0.177	-0.042
DSE34	-0.235	0.342	0.097	-0.105	0.053	0.086	0.067	-0.117	0.001	0.171
DSE35	-0.236	0.333	0.000	-0.155	0.219	0.104	-0.011	-0.227	-0.062	-0.093
DSE36	-0.110	-0.119	0.230	-0.032	0.100	0.030	0.013	0.036	-0.251	0.147
DSE37	-0.126	-0.112	0.135	0.037	0.062	0.081	-0.004	0.088	-0.203	0.005
DSE38	-0.080	-0.107	0.151	0.081	0.075	-0.202	-0.047	-0.145	-0.006	0.011
DSE39	-0.120	-0.089	0.188	0.046	0.048	-0.012	-0.007	0.004	-0.228	0.055
DSE40	-0.119	-0.126	0.220	0.080	0.103	0.268	0.141	0.230	-0.331	0.160
DSE41	-0.104	-0.148	0.125	-0.050	0.032	0.037	0.014	0.044	0.140	-0.069
DSE42	-0.097	-0.106	0.129	-0.042	0.081	0.004	0.073	0.175	0.020	0.032
DSE43	-0.150	-0.132	0.179	-0.046	0.054	0.126	0.132	0.040	0.031	-0.137
DSE44	-0.102	-0.143	0.207	-0.080	0.014	0.006	0.089	-0.018	0.174	0.057
DSE45	-0.116	-0.167	0.147	-0.009	0.054	0.051	0.060	0.059	0.138	0.034
DSE46	-0.153	-0.120	0.173	0.048	-0.051	0.032	-0.063	-0.163	0.127	-0.100
DSE47	-0.140	-0.087	0.207	0.109	-0.027	-0.148	-0.172	-0.215	0.111	0.013
DSE48	-0.126	-0.102	0.174	0.147	-0.102	-0.081	-0.180	-0.202	0.155	0.205
DSE49	-0.102	-0.120	0.116	0.018	0.010	-0.124	-0.010	0.001	0.152	0.041
DSE50	-0.143	-0.137	0.163	-0.054	0.056	0.110	0.057	-0.070	0.074	0.007

Table V.9b TAMU Principal Component Analysis for DSE Items 26-50

DSE ITEM	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
DSE1	-0.105	-0.095	-0.195	-0.126	-0.028	0.029	-0.119	0.061	-0.293	0.014
DSE2	-0.099	0.005	-0.221	-0.005	-0.126	-0.073	-0.457	-0.040	-0.081	0.155
DSE3	-0.132	-0.196	0.016	-0.240	-0.149	0.057	-0.006	0.235	-0.275	-0.031
DSE4	-0.094	-0.087	0.045	0.100	-0.047	0.131	-0.423	0.151	-0.033	-0.069
DSE5	-0.070	-0.093	-0.013	0.145	-0.038	0.021	0.320	-0.025	-0.391	-0.033
DSE6	-0.061	0.022	0.140	0.264	-0.432	-0.092	0.027	0.179	0.099	-0.088
DSE7	-0.104	-0.127	0.155	-0.163	0.049	0.007	0.002	-0.040	-0.219	0.133
DSE8	-0.147	-0.045	0.113	-0.136	0.147	-0.102	-0.007	-0.162	-0.169	0.000
DSE9	-0.128	-0.101	0.125	-0.140	0.101	-0.051	0.120	-0.096	-0.046	-0.071
DSE10	-0.136	-0.111	0.096	-0.150	0.161	-0.122	0.043	-0.057	0.000	0.099
DSE11	-0.115	-0.076	0.213	-0.070	0.176	-0.061	0.085	-0.269	0.077	0.022
DSE12	-0.094	-0.081	0.033	-0.015	0.122	-0.244	-0.015	-0.097	-0.011	-0.169
DSE13	-0.154	-0.038	0.167	0.021	0.179	0.116	-0.044	0.021	-0.003	-0.002
DSE14	-0.165	-0.104	0.097	0.104	0.157	0.012	0.035	0.180	0.051	-0.120
DSE15	-0.162	-0.125	0.113	0.031	0.022	0.178	-0.015	0.084	0.116	-0.278
DSE16	-0.159	-0.136	0.066	-0.079	0.026	0.049	-0.041	0.113	0.096	-0.323
DSE17	-0.148	-0.096	0.125	-0.068	0.069	0.079	-0.004	0.059	0.100	-0.005
DSE18	-0.067	0.006	-0.025	0.261	-0.219	0.068	0.118	0.156	-0.132	-0.070
DSE19	-0.129	0.028	0.296	0.163	-0.277	0.355	-0.128	-0.511	0.151	0.144
DSE20	-0.076	0.057	0.172	0.190	-0.104	-0.203	0.298	-0.098	-0.063	-0.093
DSE21	-0.151	0.094	0.176	0.185	-0.127	0.042	0.125	-0.068	-0.256	0.204
DSE22	-0.149	-0.031	0.030	0.227	-0.033	-0.154	-0.144	0.162	-0.110	0.103
DSE23	-0.140	-0.144	0.224	-0.194	-0.263	0.089	-0.058	-0.053	0.109	0.017
DSE24	-0.122	-0.005	-0.008	0.198	-0.036	-0.216	0.019	0.012	-0.160	0.023
DSE25	-0.175	-0.070	0.081	0.039	-0.008	-0.012	-0.097	0.022	-0.034	-0.011

Table V.10a UKY Principal Component Analysis for DSE Items 1-25

DSE ITEM	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
DSE26	-0.157	-0.063	0.080	0.119	0.007	-0.254	-0.151	0.258	0.137	0.101
DSE27	-0.186	0.039	0.135	0.159	0.089	-0.087	0.028	0.113	0.144	0.328
DSE28	-0.165	-0.029	0.017	0.091	0.076	0.076	-0.172	0.001	-0.194	-0.018
DSE29	-0.153	0.008	0.041	0.004	0.040	0.049	0.034	0.122	-0.021	0.010
DSE30	-0.221	0.398	-0.124	0.017	0.063	-0.111	-0.242	-0.291	-0.268	-0.124
DSE31	-0.210	0.321	-0.079	-0.023	0.229	0.227	0.096	0.112	0.105	0.187
DSE32	-0.223	0.301	-0.009	-0.222	-0.244	-0.412	0.059	0.010	0.294	-0.045
DSE33	-0.186	0.216	-0.131	0.032	0.132	0.294	0.143	0.194	0.107	0.283
DSE34	-0.226	0.343	0.081	-0.022	0.177	-0.066	-0.002	0.133	0.020	-0.213
DSE35	-0.231	0.262	-0.116	-0.343	-0.318	0.203	0.155	0.010	-0.132	-0.139
DSE36	-0.097	-0.063	-0.173	0.131	0.039	0.047	0.054	-0.018	0.042	-0.073
DSE37	-0.103	-0.104	-0.192	0.133	0.014	-0.033	0.166	-0.068	0.000	0.079
DSE38	-0.050	-0.062	-0.097	0.130	-0.051	0.152	-0.001	0.007	0.081	-0.083
DSE39	-0.120	-0.145	-0.097	-0.022	0.068	-0.035	0.092	0.016	0.009	-0.010
DSE40	-0.099	-0.193	-0.209	-0.166	-0.188	-0.143	0.133	0.001	0.086	0.359
DSE41	-0.148	-0.138	0.000	-0.023	0.085	0.004	-0.081	-0.105	0.064	-0.015
DSE42	-0.106	-0.132	-0.148	0.024	-0.017	0.052	0.171	-0.056	-0.049	0.066
DSE43	-0.155	-0.132	-0.121	-0.152	-0.152	0.071	-0.002	0.035	0.192	-0.044
DSE44	-0.126	-0.060	-0.145	0.112	0.052	0.137	0.027	-0.078	0.130	-0.070
DSE45	-0.137	-0.151	-0.073	0.040	0.060	-0.156	-0.011	-0.134	0.094	0.111
DSE46	-0.123	-0.091	-0.180	0.169	0.020	-0.039	0.113	-0.144	0.121	-0.203
DSE47	-0.094	-0.091	-0.160	-0.008	0.004	0.097	0.125	0.000	0.015	-0.187
DSE48	-0.069	-0.009	-0.302	0.144	-0.031	-0.073	-0.061	-0.238	0.089	-0.177
DSE49	-0.111	-0.069	-0.243	0.134	0.091	0.066	-0.034	-0.066	0.061	0.076
DSE50	-0.148	-0.134	-0.146	-0.112	-0.077	-0.043	-0.034	-0.058	0.021	0.125

Table V.10b UKY Principal Component Analysis for DSE Items 26-50

DSE ITEM	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
DSE1	-0.098	0.165	-0.020	0.226	-0.097	0.045	-0.147	0.080	-0.015	0.189
DSE2	-0.073	0.160	0.143	0.161	-0.289	0.293	-0.299	0.280	-0.043	0.054
DSE3	-0.102	0.186	-0.039	-0.166	-0.176	0.140	-0.137	0.201	0.008	-0.254
DSE4	-0.052	0.048	0.090	-0.028	-0.210	0.142	-0.056	-0.047	0.070	-0.137
DSE5	-0.132	-0.006	0.027	0.010	0.208	0.001	-0.052	-0.189	-0.025	0.050
DSE6	-0.101	0.014	0.043	0.071	0.071	0.088	-0.208	-0.259	-0.022	-0.045
DSE7	-0.137	0.089	-0.094	-0.074	0.142	-0.006	-0.084	0.120	0.067	-0.089
DSE8	-0.109	0.090	-0.155	-0.048	0.203	0.019	-0.048	-0.026	-0.059	-0.177
DSE9	-0.093	0.147	-0.127	-0.136	0.149	0.035	-0.054	-0.049	0.095	-0.028
DSE10	-0.082	0.165	-0.094	-0.179	0.100	0.053	0.055	-0.040	0.074	0.098
DSE11	-0.127	0.142	-0.083	-0.126	0.132	0.007	-0.095	-0.021	-0.036	-0.005
DSE12	-0.073	0.158	-0.200	-0.030	0.016	-0.104	-0.316	-0.152	-0.086	0.551
DSE13	-0.151	0.074	-0.059	-0.073	0.189	0.031	-0.078	0.141	-0.102	-0.118
DSE14	-0.123	0.085	0.002	-0.110	0.057	-0.109	-0.072	-0.054	-0.109	0.022
DSE15	-0.162	0.035	0.053	-0.015	0.085	-0.033	0.213	0.290	0.028	0.172
DSE16	-0.146	0.099	-0.185	-0.068	0.131	0.010	-0.075	0.071	-0.070	-0.100
DSE17	-0.103	0.124	-0.102	-0.049	0.113	-0.081	-0.005	0.073	0.056	0.027
DSE18	-0.129	0.018	0.252	0.084	-0.129	0.206	-0.268	-0.054	0.216	0.047
DSE19	-0.086	-0.042	0.437	-0.295	0.211	0.142	0.136	0.197	-0.069	0.166
DSE20	-0.085	0.028	0.385	0.091	0.268	0.097	-0.033	-0.089	0.017	-0.050
DSE21	-0.130	0.054	0.332	0.184	0.172	-0.265	-0.070	-0.071	0.300	-0.082
DSE22	-0.104	0.023	0.149	-0.098	0.246	-0.090	-0.258	-0.080	0.203	0.028
DSE23	-0.091	0.083	-0.010	0.168	0.039	-0.145	-0.023	0.007	0.188	-0.063
DSE24	-0.096	0.053	0.111	-0.152	-0.106	-0.014	0.071	0.065	0.003	-0.257
DSE25	-0.084	0.047	0.066	-0.106	-0.306	-0.311	-0.198	-0.172	-0.290	-0.135

Table V.11a KU Principal Component Analysis for DSE Items 1-25

DSE ITEM	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
DSE26	-0.101	0.107	0.297	-0.065	-0.161	-0.161	0.185	-0.037	0.009	-0.015
DSE27	-0.167	0.043	0.029	0.147	0.002	-0.168	-0.153	0.119	-0.007	-0.073
DSE28	-0.114	0.213	0.198	-0.319	-0.332	-0.233	-0.022	-0.144	-0.136	0.162
DSE29	-0.120	0.079	-0.005	0.061	-0.011	-0.075	-0.061	0.050	0.119	-0.127
DSE30	-0.329	-0.324	-0.074	0.147	-0.135	-0.093	0.056	0.033	0.303	0.218
DSE31	-0.209	-0.237	-0.018	0.028	-0.116	0.032	0.005	-0.397	-0.023	-0.224
DSE32	-0.305	-0.268	-0.152	0.046	-0.117	0.179	0.038	-0.187	0.114	0.027
DSE33	-0.211	-0.160	-0.037	-0.058	-0.033	-0.158	-0.042	0.262	-0.069	0.052
DSE34	-0.255	-0.250	-0.018	-0.107	0.002	-0.372	0.148	0.159	-0.061	-0.073
DSE35	-0.301	-0.379	0.021	-0.126	0.023	0.324	-0.118	0.114	-0.332	0.099
DSE36	-0.112	0.089	-0.037	0.279	-0.012	-0.042	0.073	0.102	-0.061	-0.018
DSE37	-0.089	0.131	0.013	0.274	-0.074	-0.033	0.150	0.064	-0.103	0.119
DSE38	-0.144	0.154	-0.080	-0.232	-0.046	0.258	0.169	-0.136	0.215	-0.004
DSE39	-0.128	0.122	-0.033	0.090	0.060	0.010	0.084	-0.017	-0.209	-0.023
DSE40	-0.091	0.155	-0.072	0.120	-0.017	-0.048	0.203	-0.060	-0.020	0.177
DSE41	-0.104	0.123	-0.054	0.096	0.006	-0.027	0.069	0.114	-0.064	-0.106
DSE42	-0.103	0.107	-0.157	-0.010	0.007	-0.030	0.101	-0.129	0.045	0.014
DSE43	-0.150	0.050	-0.104	0.081	-0.045	0.062	0.056	0.069	0.038	-0.207
DSE44	-0.112	0.125	-0.122	0.027	-0.008	0.044	-0.042	-0.021	0.058	-0.174
DSE45	-0.116	0.127	-0.067	0.012	-0.059	-0.039	0.077	0.035	-0.057	-0.014
DSE46	-0.082	0.086	0.101	0.162	0.085	0.099	0.094	-0.022	-0.222	0.029
DSE47	-0.131	0.078	0.102	0.195	0.178	0.077	0.162	-0.277	-0.378	0.001
DSE48	-0.070	0.128	0.090	0.175	-0.106	0.130	0.242	-0.061	-0.059	-0.088
DSE49	-0.112	0.138	-0.006	-0.226	-0.108	0.123	0.285	-0.134	0.181	0.124
DSE50	-0.097	0.122	-0.017	0.049	-0.073	0.092	0.136	0.056	0.150	0.135

Table V.11b KU Principal Component Analysis for DSE Items 26-50

Using factor analysis and principal component analysis was useful in helping to understand the data provided by the students through pre-treatment survey and post-treatment survey self-efficacy scores. The lack of homogeneity of covariance matrices necessitated the use of a theoretical grouping of perceived DSE-M measures. These groupings were based upon Bernard Hoesli’s design pedagogy. The use of groupings to provide a structure for the data is supported by self-efficacy review of literature (Bandura, 1997).

V.3.2.5 Design Self-Efficacy Per Item Analysis

This subchapter focuses on the per item measures of Design Self-Efficacy. During the first time point, at the beginning of the semester, two hundred sixty-two students completed the survey. The survey included a sample of all undergraduate and graduate academic levels – Freshman (U1), Sophomore (U2), Junior (U3), Senior (U4), and Graduate (G7) at TAMU, UKY, and KU who were enrolled in architectural design studios. There was parity among all three institutions for the baseline DSE-M measure with 28% of the DSE average mean values reported high Design Self-Efficacy Mastery (in the 80-89 range), 60% of the DSE-M average mean values reported moderate Design Self-Efficacy Mastery (in the 70-79 range) and 12% of the DSE-M average means values reported low Design Self-Efficacy Mastery (in the 50-69 range).

The DSE-M items that students perceived as high self-efficacy as a baseline measure include:

- DSE_5 - Use representational media (e.g., models, drawings) that is appropriate for other designers,
- DSE_6 - Use representational media (e.g., models, drawings) that is appropriate for the general public,
- DSE_7 - Gather information relevant to a project,
- DSE_8 - Select appropriate precedent,
- DSE_10 - Connect my precedents to the design project I am completing,
- DSE_23 - Identify the design problem,
- DSE_29 - Respond to specific site characteristics in my designs,
- DSE_36 - Talk about specific parts of my drawings, models, and other visuals,

- DSE_37 - Clearly explain the details of my drawings, models, and other visuals,
- DSE_38 - Respond to questions without being defensive,
- DSE_39 - Use my visuals to explain my design concept,
- DSE_40 - Explain my design process from start to finish,
- DSE_41 - Describe the design problem that was given to me,
- DSE_42 - Show the connection between my original concept and my final design,
- DSE_44 - Use language that is appropriate for my audience,
- DSE_45 - Persuade my audience of why my concept is appropriate for the design problem I was given,
- DSE_47 - Use professional looking visuals,
- DSE_48 - Appear confident, and
- DSE_49 - Reflect on both positives and negatives when responding to questions about my work.

These scores reflect the items that are most relevant to graphic communication of a design solution. When analyzed within self-efficacy theory, the possible reasons why these scores may have been reported higher than the others could relate to a student's previous success in presenting their materials in process notebooks, studio portfolios, desk crits, informal design reviews, and formal design reviews, a student's familiarity with the design presentation process, and a student's increased value on presenting their design work.

The DSE-M items that students perceived as moderate Design Self-Efficacy Mastery as a baseline measure include:

- DSE_1 - Use effective oral communication that is appropriate for other people within the profession,
- DSE_2 - Use effective oral communication that is appropriate for the general public,
- DSE_3 - Write effectively for an audience of other designers,
- DSE_4 - Write effectively for the general public,
- DSE_9 - Thoroughly analyze the precedents I choose for a project,
- DSE_11 - Translate what I see in precedents to develop a range of solutions,
- DSE_12 - Critically evaluate my iterations,
- DSE_13 - Collect relevant information to support conclusions related to a specific project,
- DSE_14 - Use formal, organization, and environmental principles to inform my designs,
- DSE_15 - Apply the fundamentals of ordering systems to natural and formal ordering systems,
- DSE_16 - Identify relevant precedents for a project,
- DSE_17 - Use principles derived from precedents to inform my design projects,
- DSE_18 - Create technically clear drawings,

- DSE_20 - Construct models that illustrate and identify all necessary information for a building design,
- DSE_22 - Utilize the principles of environmental systems to develop designs for an environmentally responsive building for a given geographic region,
- DSE_24 - Set evaluative criteria for possible designs,
- DSE_25 - Analyze designs using set criteria,
- DSE_26 - Predict the effectiveness of a design if implemented,
- DSE_27 - Make design decisions in complex projects while considering the variety of influences (e.g., accessibility, environmental systems, structural systems),
- DSE_28 - Develop a user needs assessment and analysis to respond effectively and efficiently to stated project requirements,
- DSE_31 - Determine allowable area and height,
- DSE_33 - Establish points of exit,
- DSE_43 - Use design terminology correctly,
- DSE_46 - Make my audience believe I am a credible designer, and
- DSE_50 - Explain my concept in specific terms.

These scores reflect the items that are most relevant to design research, project development, iteration, and evaluation as well as the oral and written communication of a design solution. When analyzed within self-efficacy theory, the possible reasons why these scores may have been reported higher than the others could relate to a student's previous success in writing about their design process and presenting their designs in design studio reviews, and a student placing higher value on the design development process.

The DSE-M items that students perceived as low self-efficacy as a baseline measure include:

- DSE_19 – Prepare Outline Specifications,
- DSE_21 - Demonstrate the mechanics and material behavior related to building structures through drawings, details, and structural analysis,
- DSE_30 - Determine the applicable building code, occupancy group(s), and construction type,
- DSE_32 - Calculate occupant load,
- DSE_34 - Check egress paths for travel distance,
- DSE_35 - Determine fixture counts.

These scores reflect the items that are most relevant to the realness of a project such as criteria such as the Health, Safety, and Welfare of a design solution; Health, Safety, and Welfare are central requirements for passing the Architectural Registration Examination (NCARB, 2015). When analyzed within self-efficacy theory, the possible reasons why these scores may been reported lower than the others could relate to a students' lack of previous success in relation to the subject matter, a lack of perceived value in relation to the task, a lack of knowledge of the subject matter or unfamiliarity with the task, or the information was new to the student.

Since KU did not complete the second survey, the data collected as the second DSE-M measurements only include students responses from TAMU and UKY. During the second time point, at the end of the semester, one hundred one students completed the survey. The survey included all undergraduate and graduate academic levels – U1, U2, U3, U4, and G7. There was parity among all three institutions for the DSE measurements with 18% of the DSE-M average mean values reported high values (in the 80-89 range), 62% of the DSE-M average mean values reported moderate values (in the 70-79 range) and 20% of the DSE-M average means values reported low values (in the 50-69 range).

The DSE-M items that students perceived as high self-efficacy as a post-treatment measure include:

- DSE_5 - Use representational media (e.g., models, drawings) that is appropriate for other designers,
- DSE_6 - Use representational media (e.g., models, drawings) that is appropriate for the general public,
- DSE_36 - Talk about specific parts of my drawings, models, and other visuals,
- DSE_38 - Respond to questions without being defensive,
- DSE_39 - Use my visuals to explain my design concept,
- DSE_40 - Explain my design process from start to finish,
- DSE_41 - Describe the design problem that was given to me,
- DSE_42 - Show the connection between my original concept and my final design, and
- DSE_44 - Use language that is appropriate for my audience.

These scores reflect the items that are most relevant to oral, written, and graphic communication of a design solution. When analyzed within self-efficacy theory, the possible reasons why these scores may been reported higher than the others could relate to a student's previous success in presenting their materials in process notebooks, studio portfolios, desk crits, informal design reviews, and formal design reviews, a student's familiarity with the design presentation process, and a student's increased value on presenting their design work. When compared to the results from the first time point the DSE-M measures that were not reported at this highest level and therefore declined over the course of the semester were:

- DSE_7 - Gather information relevant to a project,
- DSE_8 - Select appropriate precedents,
- DSE_23 - Identify the design problem,
- DSE_29 - Respond to specific site characteristics in my designs,
- DSE_37 - Clearly explain the details of my drawings, models, and other visuals,
- DSE_45 - Persuade my audience of why my concept is appropriate for the design problem I was given,
- DSE_47 - Use professional looking visuals,
- DSE_48 - Appear confident, and
- DSE_49 - Reflect on both positives and negatives when responding to questions about my work.

When analyzed within self-efficacy theory, the possible reasons for the decline in measurement over the course of the semester could relate to a misalignment between the goals that the faculty set for a project and the student goals perceived for a project, the lack of honest, timely, or explicit feedback to the students, the lack of student persistence or motivation to complete a given task.

The DSE-M items that students perceived as moderate Design Self-Efficacy Mastery as a post-semester measure include:

- DSE_1 - Use effective oral communication that is appropriate for other people within the profession,
- DSE_2 - Use effective oral communication that is appropriate for the general public,
- DSE_4 - Write effectively for the general public,
- DSE_7 - Gather information relevant to a project,
- DSE_8 - Select appropriate precedents,
- DSE_9 - Thoroughly analyze the precedents I choose for a project,
- DSE_10 - Connect my precedents to the design project I am completing,
- DSE_11 - Translate what I see in precedents to develop a range of solutions,
- DSE_12 - Critically evaluate my iterations,
- DSE_13 - Collect relevant information to support conclusions related to a specific project,
- DSE_14 - Use formal, organization, and environmental principles to inform my design,

- DSE_16 - Identify relevant precedents for a project,
- DSE_17 - Use principles derived from precedents to inform my design project,
- DSE_18 - Create technically clear drawings,
- DSE_20 - Construct models that illustrate and identify all necessary information for a building design,
- DSE_23 - Identify the design problem,
- DSE_24 - Set evaluative criteria for possible designs,
- DSE_25 - Analyze designs using set criteria,
- DSE_26 - Predict the effectiveness of a design if implemented,
- DSE_27 - Make design decisions in complex projects while considering the variety of influences (e.g., accessibility, environmental systems, structural systems),
- DSE_29 - Respond to specific site characteristics in my designs,
- DSE_31 - Determine allowable area and height,
- DSE_33 - Establish points of exit,
- DSE_37 - Clearly explain the details of my drawings, models, and other visuals,
- DSE_43 - Use design terminology correctly,
- DSE_45 - Persuade my audience of why my concept is appropriate for the design problem I was given,
- DSE_46 - Make my audience believe I am a credible designer,

- DSE_47 - Use professional looking visuals,
- DSE_48 - Appear confident,
- DSE_49 - Reflect on both positives and negatives when responding to questions about my work, and
- DSE_50 - Explain my concept in specific terms.

The decrease in reported scores could be attributed to a student's lack of success during the course of the semester, a student's perceived conflict between team members, or a student's perceived capability in preparing for the final formal review. Recognizing this decrease in Design Self-Efficacy could lead educators to adjust design pedagogy and studio culture. In this sense, the DSE instrument could prove to be an effective heuristic for structuring the design studio. If the faculty can rigorously assess the student by using the DSE instrument and reveal observed deficiencies, then the faculty could increase their presence as facilitator of communication in "helping the student to visualize both horizontal and vertical integration of performative relationships and how it relates back to their concepts" (UKY Interviews, 2016), provide additional motivational guidance that result in their students to aspiring to and achieving at a higher level, or reintroduce concepts that close the learning gap for the students.

The DSE-M items that students perceived as low self-efficacy as a post-semester measure include:

- DSE_3 - Write effectively for an audience of other designers,
- DSE_15 - Apply the fundamentals of ordering systems to natural and formal ordering systems,

- DSE_19 – Prepare Outline Specifications,
- DSE_21 - Demonstrate the mechanics and material behavior related to building structures through drawings, details, and structural analysis,
- DSE_22 - Utilize the principles of environmental systems to develop designs for an environmentally responsive building for a given geographic region,
- DSE_28 - Develop a user needs assessment and analysis to respond effectively and efficiently to stated project requirements,
- DSE_30 - Determine the applicable building code, occupancy group(s), and construction type,
- DSE_32 - Calculate occupant load,
- DSE_34 - Check egress paths for travel distance, and
- DSE_35 - Determine fixture counts.

Similar to scores reported for the first time point, these score reflect the items that are most relevant to the realness of a project such as criteria such as the Health, Safety, and Welfare of a design solution; Health, Safety, and Welfare are central requirements for passing the Architectural Registration Examination (NCARB, 2015).

When analyzed within self-efficacy theory, the possible reasons why these scores may have been reported lower than the others could relate to students' lack of previous success in relation to the subject matter, a lack of perceived value in relation to the task, or a lack of knowledge or unfamiliarity with the task.

Each of these reasons could have pedagogical implications: first, aligning curricular learning objectives that reinforce the knowledge exchange between the faculty and student thus adding perceived value that positively reinforces a student's perceptions of the subject matter content; second, leveraging the NAAB designations of understanding or ability, so that the program curriculum and allied studio courses build upon one another and strategically reinforce concepts and tasks so that a student's confidence in the capabilities develops throughout the curriculum, and third, to engage in real projects where these real criteria need to be addressed in the realization or simulation of a project.

V.3.2.6 Design Self-Efficacy Theoretical Grouping Analysis

The following discussion focuses on the theoretical grouping of measures of Design Self-Efficacy. The scores for these groups are reported as the degree of change of DSE-M between the data collection points, the first time point (beginning of the semester) and the second time point (end of the semester). This analysis is based upon data received from students who participated in the research at both time points; the students who participated in only the first time point or only the second time point are not included in these findings. Further, the analysis was completed for each academic level from undergraduate (U1, U2, U3, and U4) to graduate (G7) to see the influence of teaching, studio type, and project type on the student's reported DSE measures. This analysis was also done collectively and per institution to see if the trends were similar.

Bernard Hoesli references three theoretical groupings as "essential and interrelated abilities" that architectural design students must possess. Theoretical groupings are: 1) ability to evolve an idea in response to site constraints, program requirements, and structure that result in a meaningful solution, 2) the ability to develop the idea in architectural terms, and 3) the ability to present the idea in drawings or models. These theoretical groupings correspond to the five groups that emerged from the exploratory factor analysis (Design Research, Design Iteration and Analysis, Design Evaluation, Graphic Communication, and Written Communication). In reviewing the delta in Design Self-Efficacy over the course of the semester for both TAMU and UKY the following results are visually apparent (Figure V.4).

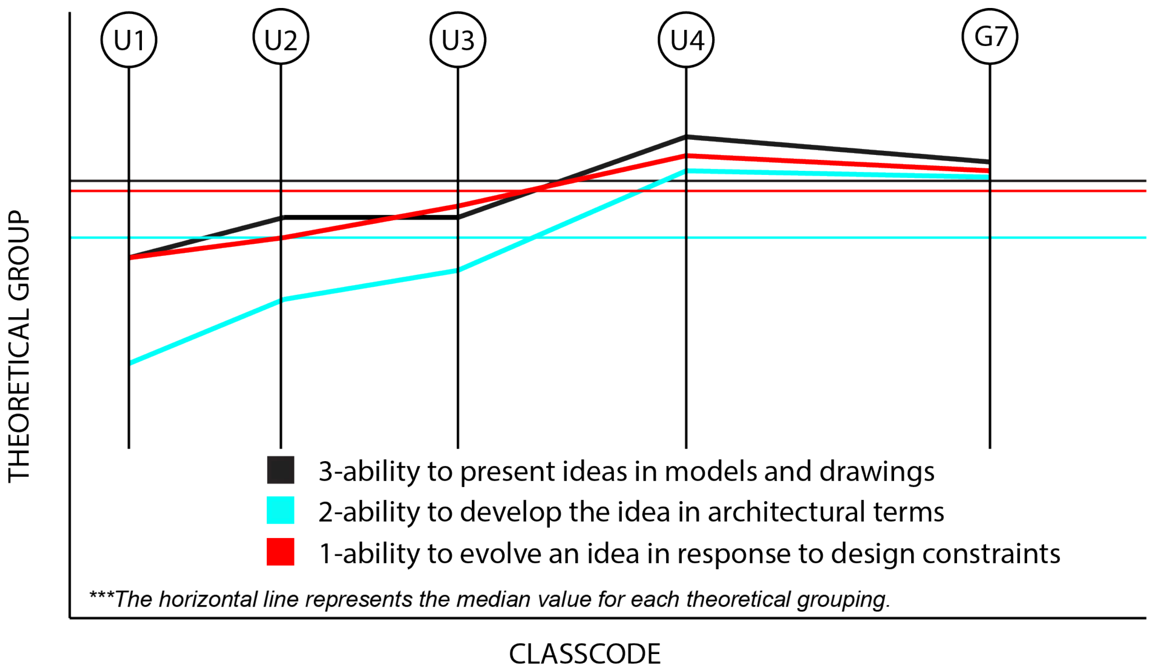

Figure V.4: Theoretical Groups Analyzed Per Academic Level Revealed Similar Trends Per Year and Per Institution.

In theoretical group 1, students enrolled in first year and second year architectural design studios have a decrease in self-efficacy, with first year students having the largest degree of negative change. Students enrolled in third year architectural design studios reported no change in self-efficacy. Students enrolled in fourth year and graduate architectural design studios had an increase in self-efficacy, with fourth year students having the largest degree of positive change. In theoretical group 2, students enrolled in first year, second year, and third architectural design studios have a decrease in self-efficacy with first year students having the largest degree of negative change. Students enrolled in fourth year and graduate architectural design studios had an increase in self-efficacy, with fourth year students having the largest degree of positive change. In theoretical group 3, students enrolled in first year, second year, and third year architectural design studios have a decrease in self-efficacy with first year students having the largest degree of negative change and second and third year students reporting about the same degree of negative change. Students enrolled in fourth year and graduate architectural design studios had an increase in self-efficacy, with fourth year students having the largest degree of positive change.

When studied separately, the following results are visually apparent for TAMU. In theoretical group 1, students enrolled in first year and second year architectural design studios have lower self-efficacy with first year students having the largest degree of negative change. Students enrolled in third year and fourth year architectural design studios had an increase in self-efficacy with fourth year students having the largest degree of positive change. Students enrolled in graduate architectural design studios had no reported change in self-efficacy. In theoretical group 2, students enrolled in first year, second year, and third year architectural design studios have a decrease in self-efficacy with first year students having the largest degree of negative change. Students enrolled in fourth year and graduate architectural design studios had an increase in self-efficacy, with fourth year students having the largest degree of positive change. In theoretical group 3, students enrolled in first year, second year, and third year architectural design studios have a decrease in self-efficacy with first year students having the largest degree of negative change and second and third year students reporting about the same degree of negative change. Students enrolled in fourth year and graduate architectural design studios had an increase in self-efficacy, with fourth year students having the largest degree of positive change.

The following results are visually apparent for UKY. In theoretical group 1, students enrolled in first year, second year have a decrease in self-efficacy with third year students having the largest degree of negative change. Students enrolled in fourth year and graduate architectural design studios had an increase in self-efficacy with fourth year students having the largest degree of positive change. In theoretical group 2, students enrolled in first year and second year architectural design studios have a decrease in self-efficacy with second year students having only a slight negative change in self-efficacy. Students enrolled in fourth year and graduate architectural design studios had an increase in self-efficacy with fourth year students having the largest degree of positive change. In theoretical group 3, students enrolled in first year and second year architectural design studios have a decrease in self-efficacy with first year students having the largest degree of negative change. Students enrolled in fourth year and graduate architectural design studios had an increase in self-efficacy with fourth year students having the largest degree of positive change.

V.3.2.7 Design Self-Efficacy Theoretical Grouping Change in SE Analysis

This data was also examined for degree of change for each academic level per DSE-M item per theoretical grouping to predict the impact on the overall group measure. For this analysis, because of the larger sample size (n=89) only the data collected from TAMU was used. This data is presented with a 95% Confidence Interval.

In looking at the error bars for TAMU-Theoretical Group 1 the following values were analyzed (Appendix 11). For U1, of the fifteen DSE-M items included in this grouping seven items reported positive change in self-efficacy, one item reported no change in self-efficacy, and seven items reported negative change in self-efficacy. Of the seven items that reported positive change, *DSE_12 - Critically evaluate my iterations*, reported the highest degree of positive change; *DSE_16 - Identify relevant precedents for a project*, reported no change in self-efficacy; and of the seven items that reported negative change, *DSE_24 - Set evaluative criteria for possible designs*, reported the highest degree of negative change. For U2, of the fifteen DSE-M items included in this grouping eight items reported positive change in self-efficacy and seven items reported negative change in self-efficacy. Of the eight items that reported positive change, *DSE_22 - Utilize the principles of environmental systems to develop designs for an environmentally responsive building for a given geographic region*, reported the highest degree of positive change and of the seven items that reported negative change, *DSE_10 - Connect my precedents to the design project I am completing*, reported the highest degree of negative change. For U3, of the fifteen DSE-M items included in this grouping one item reported positive change in self-efficacy and fourteen items reported negative change in self-efficacy. The one item that reported positive change, *DSE_7 - Gather information relevant to a project*, reported the highest degree of positive change and *DSE_24 - Set evaluative criteria for possible designs*, reported the highest degree of negative change. For U4, of the fifteen DSE-M items included in this grouping five items reported positive change in self-efficacy and ten items reported negative change in self-efficacy. Of the five items that reported positive change, *DSE_22 - Utilize the principles of environmental systems to develop designs for an environmentally responsive building for a given geographic region*, reported the highest degree of positive change and of the ten items that reported negative change, *DSE_24 - Set evaluative criteria for possible designs,* reported the highest degree of negative change. For G7, of the fifteen DSE-M items included in this grouping seven items reported positive change in self-efficacy and eight items reported negative change in self-efficacy. Of the seven items that reported positive change, *DSE_28 - Develop a user needs assessment and analysis to respond effectively and efficiently to stated project requirements*, reported the highest degree of positive change and of the eight items that reported negative change, *DSE_41 - Describe the design problem that was given to me*, reported the highest degree of negative change.

In looking at the error bars for TAMU-Theoretical Group 2 the following values were analyzed (Appendix 11). For U1, of the thirteen DSE-M items included in the grouping, five items reported positive change in self-efficacy and eight items reported negative change in self-efficacy. Of the five items that reported positive change, *DSE_35 - Determine fixture counts*, reported the highest degree of positive change and of the eight items that reported negative change, *DSE_21 - Demonstrate the mechanics and material behavior related to building structures through drawings, details, and structural analysis,* reported the highest degree of negative change. For U2, of the thirteen DSE-M items included in this grouping eleven items reported positive change in self-efficacy and two items reported negative change in self-efficacy. Of the eleven items that reported positive change, *DSE_32 - Calculate occupant load,* reported the highest degree of positive change and of the seven items that reported negative change, *DSE_29 - Respond to specific site characteristics in my designs,* reported the highest degree of negative change. For U3, of the thirteen DSE-M items included in this grouping two items reported positive change in self-efficacy and eleven items reported negative change in self-efficacy. Of the two items that reported positive change, *DSE_1 - Use effective oral communication that is appropriate for other people within the profession,* reported the highest degree of positive change and of the eleven items that reported negative change, *DSE_35 - Determine fixture counts,* reported the highest degree of negative change. For U4, of the thirteen DSE-M items included in this grouping two items reported positive change in self-efficacy and eleven items reported negative change in self-efficacy. Of the two items that reported positive change, *DSE_29 - Respond to specific site characteristics in my designs,* reported the highest degree of positive change and of the eleven items that reported negative change, *DSE_32 - Calculate occupant load,* reported the highest degree of negative change. For G7, of the thirteen DSE-M items included in this grouping eight items reported positive change in self-efficacy and five items reported negative change in self-efficacy. Of the eight items that reported positive change, *DSE_35 - Determine fixture counts,* reported the highest degree of positive change and of the seven items that reported negative change, *DSE_27 - Make design decisions in complex projects while considering the variety of influences (e.g., accessibility, environmental systems, structural systems),* reported the highest degree of negative change.

In looking at the error bars for TAMU-Theoretical Group 3 the following values were analyzed (Appendix 11). For U1, of the twenty-two DSE-M items included in these grouping twelve items reported positive change in self-efficacy and ten items reported negative change in self-efficacy. Of the twelve items that reported positive change, *DSE_1 - Use effective oral communication that is appropriate for other people within the profession*, reported the highest degree of positive change and of the ten items that reported negative change, *DSE_5 - Use representational media (e.g., models, drawings) that is appropriate for other designers,* reported the highest degree of negative change. For U2, of the twenty-two DSE-M items included in this grouping nine items reported positive change in self-efficacy, two reported no change in self-efficacy, and eleven items reported negative change in self-efficacy. Of the nine items that reported positive change, *DSE_6 - Use representational media (e.g., models, drawings) that is appropriate for the general public,* reported the highest degree of positive change, *DSE_43 - Use design terminology correctly* and *DSE_47 - Use professional looking visuals,* reported no change in self-efficacy, and of the eleven items that reported negative change, *DSE_46 - Make my audience believe I am a credible designer,* reported the highest degree of negative change. For U3, of the twenty-two DSE items included in this grouping seven items reported positive change in self-efficacy, two reported no change in self-efficacy, and thirteen items reported negative change in self-efficacy. Of the seven items that reported positive change, *DSE_38 - Respond to questions without being defensive*, reported the highest degree of positive change, *DSE_42 - Show the connection between my original concept and my final design* and *DSE_46 - Make my audience believe I am a credible designer*, reported no change in self-efficacy, and of the thirteen items that reported negative change, *DSE_5 - Use representational media (e.g., models, drawings) that is appropriate for other designers,* reported the highest degree of negative change. For U4, of the twenty-two DSE-M items included in this grouping all twenty-two items reported negative change in self-efficacy. Of the twenty-two items that reported negative change, *DSE_38 - Respond to questions without being defensive,* reported the lowest degree of positive change and *DSE_44 - Use language that is appropriate for my audience,* reported the highest degree of negative change. For G7, of the twenty-two DSE-M items included in this grouping five items reported positive change in self-efficacy, one item reported no change in self-efficacy, and seventeen items reported negative change in self-efficacy. Of the five items that reported positive change, *DSE_20 - Construct models that illustrate and identify all necessary information for a building design,* reported the highest degree of positive change, *DSE_47 - Use professional looking visuals,* reported no change in self-efficacy, and of the seventeen items that reported negative change, *DSE_4 - Write effectively for the general public,* reported the highest degree of negative change.

There was reported visible change in Design Self-Efficacy, however the degree of reported change was not statistically significant. The statistical analysis for this hypothesis was tested per DSE-M item and for each academic level. The degree of visible change was reported for the following ten DSE-M items and the corresponding academic level are reported in U2, U3, and U4, with most of the significant visible change occurring in U4. The visible significance is reported in the following DSE-M items: *DSE_3 - Write effectively for an audience of other designers*, U4 (p-value = 0.0515), *DSE_5 - Use representational media (e.g., models, drawings) that is appropriate for other designers*, U3 (p-value = 0.0658), *DSE_6 - Use representational media (e.g., models, drawings) that is appropriate for the general public*, U2 (p-value = 0.0989), *DSE_28 - Develop a user needs assessment and analysis to respond effectively and efficiently to stated project requirement*, U3 (p-value = 0.0629), *DSE_32 - Calculate occupant load,* U4 (p-value = 0.0467), *DSE_34 - Check egress paths for travel distance,* U4 (p-value = 0.0927), *DSE_44 - Use language that is appropriate for my audience,* U4 (p-value = 0.0109), *DSE_46 - Make my audience believe I am a credible designer*, U4 (p-value = 0.0633), *DSE_49 - Reflect on both positives and negatives when responding to questions about my work,* U4 (p-value = 0.0251), and *DSE_50 - Explain my concept in specific terms,* U4 (p-value = 0.0157). In reviewing the concepts related to each of these DSE-M items the degree of change appears to fall into two categories: 1) translating user needs and code compliance into meaningful designs and 2) then communicating those ideas through written, oral, graphic means and methods.

V.3.3 Studios Can Be Categorized into Studio Types (ST) and Project Types (PT)

There was consensus of all faculty in the focus groups regarding the topical areas related to the categorization of context (studio type) and content (project type) of design studios at the respective institutions. Faculty described the categorization of studio type (individual/team) and project type (hypothetical/real) as being an integral part of their understanding of the type of peer-to-peer learning, types of interaction, and the realms of project development across the studio curriculum. There were some challenges that emerged. For instance, one faculty commented "often in design studios, we often ask students to work in teams to solve problems or even just to do a collective studio model, but if we don't teach them how to work in a team, we're only scratching the surface of collaboration" (KU Focus group, 2016).

Studio type and project type appear to be valid ways of characterizing teaching methods. Data collected from design studio syllabi, faculty focus groups, and faculty interviews provided reasonable consensus that studio types and project types could be categorized. The categorization of studio type revealed two distinguishing values related to the context for design studios – individual or team (Table V.12). The categorization of project type revealed three distinguishing values on an ordinal scale related to the content for design studios – hypothetical, quasi-real, and real. There was consensus that these attributes could be further analyzed to reveal five additional indicators: site (PT-1), program (PT-2), client (PT-3), community involvement (PT-4), and realization (PT-5) (Table V.12). Studio types were also self-reported by students in the post-treatment survey and self-reported by faculty in an editable PDF form (Appendix 08).

COURSE	ST-Studio Type Individual Only-Both Individual and Team Work-Team Work Only	PT1-Project Site Hypothetical-QuasiReal-Real	PT2-Project Program Hypothetical-QuasiReal-Real	PT3-Project Client Hypothetical-QuasiReal-Real	PT4-Community Involvement Not Engaged-Partially Engaged-Full-Engaged	PT5-Project's Realization Unbuilt-Partially Built-Built
ENDS 105	50.00	75.00	25.00	25.00	50.00	50.00
ENDS 106	33.33	58.33	50.00	25.00	25.00	58.33
ENDS 116	33.33	33.33	25.00	25.00	33.33	41.67
ARCH 206	45.00	55.00	40.00	40.00	35.00	45.00
ARC 252	25.00	31.25	18.75	0.00	0.00	50.00
ARC 253	25.00	75.00	50.00	25.00	0.00	62.50
ARCH 305	33.33	50.00	75.00	25.00	25.00	33.33
ARC 355	50.00	100.00	58.33	50.00	41.67	41.67
ARCH 406	83.33	83.33	91.67	66.67	58.33	75.00
ARC 457	37.50	100.00	37.50	37.50	37.50	37.50
ARCH 606	41.67	100.00	100.00	100.00	66.67	50.00
ARC 659	50.00	68.75	56.25	31.25	31.25	50.00
ARCH 693	65.00	90.00	80.00	65.00	50.00	50.00
ARC 759	62.50	81.25	56.25	43.75	37.50	50.00
Summary	**45.36**	**71.52**	**54.55**	**39.94**	**35.09**	**49.64**

Table V.12 TAMU and UKY Combined Syllabi Content Summary (By Course) - Studio Type (ST) and Project Type (PT)

There was strong consensus from all faculty interviews from these three programs that relevant problems, projects, and methods of working should start and continually integrate what was referred to as *timeless principles* that are tied to the academic level of the design studio. “The tools, techniques, and issues have evolved, but the timeless design principles have endured through time” (TAMU Interviews, 2016). In first year of the foundational curriculum, students are learning how to speak the language of design while learning how to be design students. As the student develops their ability “to think, to make, to make objective judgments, and to formulate rules for a system" (KU Interviews, 2016) they are taught the fundamentals of architectural design. These first principles—space, scale, hierarchy, materiality, proportion, etc.—are deployable across time and across a range of disciplines, typologies, and scales since they can then transcend to a larger scale quite easily. As the student progresses through the program, projects move from abstract to real and from simple to complex. Faculty described the nature of this necessity by stating "I'm always one for increasing the scale and complexity of projects that students undertake. However, it is critical for faculty to teach the underlying core design principles. We do not teach museum design, we do not teach hospital design. We do not teach all of these specialist typologies. Rather, we are teaching a general design education that is providing our students with different typologies to learn and from which to develop a personal architectural voice" (TAMU Interviews, 2016).

A quantitative analysis of the studios at the three centers was conducted in two ways: first, by Studio Type (ST) and Project Type (PT) student self-reporting as an integral part of the post-treatment survey (post-semester DSE) and second, through faculty self-reporting by completing an editable PDF document. The comparisons between these three measures are included (Table V.13 and Table V.14). The composite scores are presented in three ways: by faculty, by course, and by level.

COURSE	ST-Studio Type Individual Only-Both Individual and Team Work-Team Work Only	PT1-Project Site Hypothetical-QuasiReal-Real	PT2-Project Program Hypothetical-QuasiReal-Real	PT3-Project Client Hypothetical-QuasiReal-Real	PT4-Community Involvement Not Engaged-Partially Engaged-Full-Engaged	PT5-Project's Realization Unbuilt-Partially Built-Built
ARCH 206-A	100	100	50	75	50	50
ARCH 206-B	50	50	50	50	25	50
ARCH 206-C	25	50	50	25	25	50
ARCH 206-D	25	50	25	25	50	25
ARCH 206-E	25	25	25	25	25	50
ARCH 305-A	50	25	75	25	25	25
ARCH 305-B	25	25	50	25	25	50
ARCH 305-C	25	100	100	25	25	25
ARCH 406-A	75	100	100	75	75	100
ARCH 406-B	100	100	100	50	50	50
ARCH 406-C	75	50	75	75	50	75
ARCH 606-A	25	100	100	100	75	50
ARCH 606-B	25	100	100	100	75	50
ARCH 606-C	75	100	100	100	50	50
ARCH 693-A	50	50	75	50	50	50
ARCH 693-B	100	100	50	75	25	50
ARCH 693-C	50	100	100	100	50	50
ARCH 693-D	100	100	75	50	75	50
ARCH 693-E	25	100	100	50	50	50
ENDS 105-A	50	75	25	25	50	50
ENDS 106-A	25	100	75	25	25	50
ENDS 106-B	50	50	50	25	25	75
ENDS 106-C	25	25	25	25	25	50
ENDS 116-A	25	25	25	25	25	50
ENDS 116-B	25	25	25	25	25	50
ENDS 116-C	50	50	25	25	50	25
Summary	**49.04**	**68.27**	**63.46**	**49.04**	**42.31**	**50.00**

Table V.13 TAMU Syllabi Content Summary (By Course) – Studio Type (ST) and Project Type (PT)

COURSE	ST-Studio Type Individual Only-Both Individual and Team Work-Team Work Only	PT1-Project Site Hypothetical-QuasiReal-Real	PT2-Project Program Hypothetical-QuasiReal-Real	PT3-Project Client Hypothetical-QuasiReal-Real	PT4-Community Involvement Not Engaged-Partially Engaged-Full-Engaged	PT5-Project's Realization Unbuilt-Partially Built-Built
ARC 252	25.00	31.25	18.75	0.00	0.00	50.00
ARC 253	25.00	75.00	50.00	25.00	0.00	62.50
ARC 355	50.00	100.00	58.33	50.00	41.67	41.67
ARC 457	37.50	100.00	37.50	37.50	37.50	37.50
ARC 659	50.00	68.75	56.25	31.25	31.25	50.00
ARC 759	62.50	81.25	56.25	43.75	37.50	50.00

	ST-Studio Type	PT1-Project Site	PT2-Project Program	PT3-Project Client	PT4-Community Involvement	PT5-Project's Realization
Summary	41.67	76.04	46.18	31.25	24.65	48.61

Table V.14 UKY Syllabi Content Summary (By Course) – Studio Type (ST) and Project Type (PT)

When comparing overall mean studio types (ST), the University of Kentucky design studios tended to work more individually (mean score = 41.67) while TAMU design studios tended to work in a balanced combination of individual and team projects (mean score = 49.04).

When comparing PT-1 project site (hypothetical to real) measures, both TAMU and UKY have sites that are real or actual, but UKY scores tended to be more real (mean score = 76.04) compared to TAMU (mean score = 68.27). When comparing PT-2 project program (hypothetical to real) TAMU (mean score = 63.46) tended to present students with design challenges that have higher degrees of realness compared to UKY (mean score = 46.18). When comparing PT-3 project client (hypothetical to real) TAMU (mean score = 49.04) tended to present students with Quasi-real clients and UKY (mean score

= 31.25) tended to present the students with design challenges where the studio professor served as the hypothetical project client. When comparing PT-4 community involvement (passive to active / not-engaged to partially-engaged to fully-engaged), TAMU (mean score = 42.31) had a higher degree of community involvement then UKY (mean score = 24.65), but in both centers, community involvement was partially engaged in design reviews only. When comparing PT-5 project realization (Drawn to Modeled to Drawn/Modeled/Built), TAMU (mean score = 50) had a slightly higher degree of project realization then UKY (mean score = 48.61), where projects were partially built, drawn, and modeled at some scale, but not as full-scale (Table V.15 and Table V.16). At TAMU, the highest degree of realization was reported in U1 and G7 (mean score = 50.00), U2 and U3 reported a mean score = 41.67, and the lowest degree of realization was reported in U4 (mean score = 37.50). At UKY, the highest degree of realization was reported in U2 (mean score = 62.50), U1 and G7 reported a mean score = 50, U3 reported a mean score = 41.67, and the lowest degree of realization was reported in U4 (mean score = 62.50).

COURSE	ST-Studio Type	PT1-Project Site	PT2-Project Program	PT3-Project Client	PT4-Community Involvement	PT5-Project's Realization
U1	38.89	55.55	33.33	25.00	36.11	50.00
U2	45.00	55.00	40.00	40.00	35.00	45.00
U3	33.33	50.00	75.00	25.00	25.00	33.33
U4	83.33	83.33	91.67	66.67	58.33	75.00
G7	53.34	95.00	90.00	82.50	58.34	50.00

Table V.15 TAMU Syllabi Content Summary (By Academic Level) - Studio Type (ST) and Project Type (PT)

COURSE	ST-Studio Type	PT1-Project Site	PT2-Project Program	PT3-Project Client	PT4-Community Involvement	PT5-Project's Realization
U1	25.00	31.25	18.75	0.00	0.00	50.00
U2	50.00	100.00	58.33	50.00	41.67	41.67
U3	50.00	100.00	58.33	50.00	41.67	41.67
U4	37.50	100.00	37.50	37.50	37.50	37.50
G7	56.25	75.00	56.25	37.50	34.38	50.00

Table V.16 UKY Syllabi Content Summary (By Academic Level) - Studio Type (ST) and Project Type (PT)

V.3.3.1 Projects Can Be Categorized into Studio Types (ST)

Studio type is defined as the context in which the students work: individually only, individually and in teams, or only in teams. The collected fifty syllabi (n=50) suggest that a majority of courses include individual projects although team projects are common (Table IV.2).

The syllabi characterized studio type in a variety of ways with little to no description of the studio work environment. Unless teamwork or collaboration was explicitly articulated, the implicit reference was that students would be working individually. In the cases where teamwork was defined, references were frequently described by the method of working or by the method of grading the student work. Examples of the methods related to the specific assignments: "students are expected to coordinate closely with team members in group projects" and "there will be one short introductory project, one short design project, and then a team project." Examples of the grading related the distinction between individual effort and collective contribution: "students will be evaluated on individual merit and members of a team may receive different grades," "all graded team assignments/project will receive a single team grade.

However, the grade for individual members of the team will be a function of the peer evaluation of their contribution to the team," and "for group assignments, each student will be responsible for his or her level of participation."

The explicit identification of studio types were primarily provided in the UKY Masters Project Studio Options (independent study studio option) or in the integrated, interdisciplinary, community-engaged, or design-build course offerings at the three institutions (Table IV.2). For instance, UKY ARC759 provided the statements: "Each student will select a studio project from the framework of studio options. This will establish your independent study." TAMU ARCH206-500 provided statements: "This is an interdisciplinary vertical design studio collaborating with faculty members and students in an upper level architecture course (TAMU 406-504) and a landscape architecture course (LAND421) … students will be given a budget and basic program and will work together in interdisciplinary teams to produce the required documents, and build the pavilion structure" and TAMU ARCH406-503 "our project is a vehicle for instruction in Integrated Project Delivery (IPD), Building Information Modeling (BIM), and comprehensive design. By establishing collaborative teams with students from a land development course (LDEV671-600) and a construction science course (COSC461-502), students will gain an increased understanding of these allied disciplines." A cross-listed architecture course UKY ARC659 / ARC759 provided the statement: "Working in pairs, students will develop a Shotgun House for the 21st Century." UKY 457 / ARC659 / ARC759 provided the statement: "This graduate studio is intended to prepare you for your chosen profession – architecture and its allied discipline. As part of your professional preparation, and as necessary requirement of the studio, you will be asked to work in groups and called upon to collaborate successfully with your classmates and peers." KU ARCH509 provided the statement: "Experiential learning is at the core of design-build education. As such, the studio will be working in close collaboration with external entities, including our community partner, professional consultants, and authorities having jurisdiction." KU ARCH802 provided the statements: "The focus of this studio is to work collaboratively in a process of research and discovery in order to engage additional and overlooked facets integral to architectural and urban design" and "our work (with Dotte Agency) will build capacity in the community and seek to connect individual and small-groups of student with real-world, real-partner projects."

Often learning objectives were crafted to document the entire individual student contribution to enable collaboration or teamwork gain experience, skill, and confidence in working as a team. "Each student must maintain a record of his or her work in the studio sequence." "In addition to architectural responsibilities, by the end of this course students will be able to work together in a team to address owner/client needs, construction needs, and produce a complex architectural assembly" or "to improve effective self-organization, teamwork, and time-management skills."

Given the synthesis that occurs in the design studio, it is possible for the studio to be viewed as a conduit for collaboration. Having the ability to ask questions and the ability listen to the answer are the cornerstones of collaboration. "It is really important for students to develop the capacity to listen," (KU Interviews, 2016). Scott Veazey states, "Collaboration is the ability to work with people in other fields and have the confidence and ability to ask the right question" (Personal Communication, 09 February 2016). However, as expressed and supported by evidence in the faculty interviews, collaboration does not necessarily require working across disciplines, but rather, a strategic alignment of capabilities, assets, and strategies that define the expectation and the results of the collaboration (Pisano & Verganti, 2011). The interviews with the faculty revealed a liberal and often fluctuating use of nomenclatures that describe how students worked in studio. The terms "collaboration," "cooperation," "coordination," "collectively," "in groups," "teaming," and "teamwork" were often used interchangeably. Examples of this interchangeable nomenclature usage include: "Students work individually in the initial years of the curriculum and then work both individually and in teams as they advance through the curriculum." "Students work independently or if they are building the projects, in teams." "During the initial few weeks of the semester we do precedent analysis and contextual analysis by groups. So maybe for the first two weeks, students work together to obtain information about the surrounding context through cooperative efforts." "Students work individually for four weeks and then, collectively in collaborative, interdisciplinary, teams for twelve weeks." "The studio completes a group analysis of the site and of the program. Then, the design work is done individually before working collectively to build the final project." "Students learn together in group projects where they give each other feedback as they develop the criteria for a design proposal." "For efficiency purposes, students work in two person teams or three person teams." "As the projects become more complex, I tend to focus a bit more on teaming." "Projects are necessarily small - open air pavilion type structures. I run that studio sort of like an office, in the sense that students are assigned management roles. The students are not expected to carry that role through in isolation, rather they work through the whole process from ideas to developing construction documents and shop drawings." With few exceptions, there was little evidence of the alignment of "capabilities, assets, and strategies that define the expectation and the results of the collaboration" advocated by the *Harvard Business Review* (Harvard Business Review, 2011). Rather, faculty just listed them as a method of working within the context of the studio.

"Students learn not only from the instructor, but also from the other students" (KU Interviews, 2016). Following a review, students often participate in sharing sessions to hear comments that their studio colleagues gathered for the student during the review. Decision-making in this manner is akin to a democratic process where ideas are interrogated and ideas advanced by using data provided to the student in the studio review or by the faculty. As a result of this, the student internalizes the data gathered in the review. "Each individual student has their own way or absorbing information. And some students, in my opinion, readily take on very complex ideas and they are able to effortlessly synthesize it into their work" (KU Interviews, 2016).

The reported distribution of Studio Type across the sample at ranged from individual-only (mean score = 0.00) to a balance of individual and team projects (mean score = 50.00) to team-only projects (mean score = 100.00). At TAMU, U4 reported the highest level of teamwork (mean score = 83.33), G7 and U2 reported a balance of individual and team projects (mean score = 53.34 and mean score 45.00, respectively), with U1 and U3 reported mostly individual projects (mean score = 38.89 and mean score – 33.33, respectively) (Table V.15). At UKY, G7 reported the highest level of teamwork (mean score = 56.25), U2 and U3 reported a balance of individual and team projects (mean score = 50.00), with U4 and U1 reported mostly individual projects (mean score = 37.50 and mean score – 25.00, respectively) (Table V.16).

V.3.3.2 Projects Can Be Categorized into Project Types (PT)

Project type is defined as the content of the studio as measured on the dimension of hypothetical, quasi-real, or real. For this research, Project type (PT) has five measureable attributes: site (PT-1), program (PT-2), client (PT-3), community engagement (PT-4)—defined as not-engaged (no community involvement), partially-engaged (community involved in design reviews only), or full-engaged (community involved in studio work to realize common objective through brainstorming, reviews, community presentations, feedback, and learning objectives that demonstrate a clear community benefit), and realization (PT-5)—defined as unbuilt (not modeled or constructed), partially-built (drawn and modeled at some scale, but not at full-scale), or built (drawn and modeled, and then constructed at full-scale). Project types were also self-reported by students in the post-treatment survey and self-reported by faculty in an editable PDF form (Appendix 08).

The collected fifty syllabi (n=50) revealed more hypothetical projects than quasi-real and real at TAMU; more hypothetical projects than quasi-real and real at UKY (n=15); and a balance between hypothetical and real projects and slightly less quasi-real projects at KU (Table IV.2). Projects ranged from 2-dimensional and 3-dimensional material-based investigations, across scales from scales that could fit in one's hand to full-scale objects to urban planning schemes, included all drawing conventions from hand drawn to digitally-designed and/or fabricated, from drawing to model making, from analytical presentations to full-scale constructions that were exhibited publicly such as during the TAMU Build Day or end of the year exhibitions at all three centers.

The syllabi from the three institutions demonstrate an increasing complexity as a student progresses through the curriculum often moving from abstract, theoretical, and hypothetical projects to more complex, real-world, and community-engaged projects. Many of the collected syllabi did not include the actual brief for the assignment; however, there were examples that provided a description of the site, program, client, level of community engagement, and the level of the project's realization. To address these varying degrees of complexity, students were often asked to role-play: "assume you're the developer of single family house on a standard shotgun tract in the re-emerging Portland neighborhood of West Louisville" (UKY ARCH 659 / 759). In this setting, students were asked to develop a Shotgun House for the 21st Century (as they defined it). Students were required to research the history of the American Shotgun Home typology and to conform to Louisville's Zoning and Land Use Code. This document provided guidelines for Medium Density Zone R-6, typical of the Portland neighborhood, and the requisite front, rear, and side yard setbacks as well as height restrictions. In this particular case, there was not an actual site, but a hypothetical setting. The program was quasi-real as it was self-determined but had to conform to real "unseen contextual parameters," the student acted as hypothetical the client / developer, and their was no community partner or community interaction.

This type of quasi-real project can be contrasted to the hypothetical *Object Redux* studio (TAMU ARCH206-501) and the real *Connecting the Dottes: Finding Agency in the City* studio (KU ARCH802). In the *Object Redux* studio, students were asked to "mine a found object" and analyze it in light of the "latent architectural potentials." In this context, the site was the hypothetical context of the model itself. The analysis provided the hypothetical context for the program and used digital modeling techniques and theoretical texts to provide a framework for development. This discursive studio used cultural studies and the student discovery as "the hypothetical client" to inform relationships between "social convention and the physical object." Whereas in the *Connecting the Dottes* studio, the faculty's assertion to "experience things first-hand" took students out of the studio context into the site. Students gathered data about the physicality of the site, its history, culture and topography, the program and scales of human interaction (public space, adjacencies, use groups) by working directly with the client, the *Dottes Agency*, and real-world climate data (weather and micro- / macro-climate data). The *Connecting the Dottes* syllabi also described the level of community involvement contribution of the collective design, and the stated requirement for the student to host a penultimate community event that actively engaged the community in the review and exhibition. In all three of the studio examples listed above, students were required to contribute to and complete a studio publication as a record of their learning process and project development.

Texas A&M University faculty expressed the importance of having students working individually in the first two years of the program. The rationale that the faculty provided was "to provide students with the ability to understand the limitations of their own skills when confronting types of different problems" (TAMU Focus Group, 2016). In contrast to the individualized curriculum of the first and second year, with regard to the third and fourth year of the program, faculty expressed the importance for students to work in groups.

Faculty described the unique difference between the fall and spring semester of first year. First year begins with abstract compositions that work with concepts of verticality, space, depth, and volume that are site-less. These projects gradually shift to a hypothetical site. The second semester of first year focuses on materiality and making. This semester shifts to more solid, realistic understandings and deployment of materials and tectonics and scale. The second year is typically a real site in a real context, that can be visited, where context can be discussed, and concepts like zoning setbacks can be seen.

In the third year, students are required to have a study abroad experience. The fourth year has two studios including the fall Integrated Studio. In this context, students work in teams and have integrated studio faculty that represent design, structures, and systems. Lessons from the structures and systems classes are played out and examined through the studio project. These projects have real sites and real programs, and the faculty often role-play as the client. In a few cases, there is a community-engagement in the project. These projects are developed comprehensively in model and drawing but not actualized. The second fourth-year studio was described as a fabrication studio. These projects tend to be built at full-scale and range from installations to inhabitations. The accredited Masters programs are almost always real in terms of sites, programs and clients, but are more frequently conceptual or theoretical investigations that are not built. These projects tend to increase in complexity the closer to the end of the program, as the accredited program students are required to produce life safety drawings, have an ADA-compliant and accessible structure, meet HVAC performance guidelines, and produce specifications.

The University of Kentucky defined itself as a design program that is “less mission driven on a certain topic,” but one that “actively engages design at all levels” (UKY Focus Group, 2016). Faculty described a choreographed series of lesson plans that strategically builds skills and reinforces learning objectives through a horizontally and vertically aligned common curriculum across each of the years. Within that common directive, faculty can establish their own project and methodology for achieving those objectives. This common core and diversity of approaches was expressed as desirable trait and aligns to what architect Robert Venturi referred to as a preference for “messy vitality over unity” in his seminal book *Complexity and Contradiction* (Venturi, 1977). What was described as desirable at Kentucky stood in stark contrast to the resistance that was described at Kansas in the past when curriculum was heavily coordinated. One faculty commented, “Whenever studio has attempted to be rigidly coordinated, it produced resistance from both the faculty and the student” (KU Focus Group, 2016).

At UKY, this coordinated organizational structure provided faculty opportunities for expression.

The first year studio centers on abstract concepts of point, line, plane, mass, solid, void, light, and materiality. Students work across scales and media and focus on aligning making with meaning. Student explorations are individual, the sites are hypothetical, there is no client, nor a program.

The second year projects are more real and tend to have real programs with hypothetical or idealized sites and clients. The student's work was completed individually. Two examples that were given was an addition to Richard Meier's Smith House (real site, real program, hypothetical client, but adheres to Richard Meier's principles for the Smith House) and Student Housing at the Salk Institute (real site, real program, hypothetical client, but adheres to Louis Kahn's principles for the Salk Institute). These programs relate to something that is discovered by the students through precedent analysis and then translated to serve as a parametric guideline for their project. A third example, a "cabin in the woods," was more self-referential and known to the students through first hand knowledge or through theory. One faculty commented that this type of project has hypothetical clients, programs, and sites that "cannot be found on Google Maps" (UKY Focus Group, 2016).

In third year, the projects range from an urban site (fall) to a rural site (spring). Often local sites are selected so that students can visit them. Projects tend to be hypothetical, but align with typologies that can be examined through design principles. The studio investigations are usually done individually with site models created in a collaborative manner. The manner in which faculty achieve the learning goals for the year allows the student more than one way of working -- individually or in teams. One faculty commented, “students are very strategic relative to skills or knowledge that they are missing, and about who they can work with in order to pick up those skills” (UKY Focus Group, 2016).

In the fourth year, studios are required in only one semester, but as noted “students who are really rigorous and who want to challenge themselves, take two studios” (UKY Focus Group, 2016). These studios are typically hypothetical and aligned with faculty research initiatives. The students work both individually and collaboratively, on projects that may have real clients and be built. The graduate studios are aligned with integrated studios. These projects are almost always completed in teams of two students. These projects are typically community-oriented, with real clients who are active throughout the design, review, and development of the project. These projects have real sites but, with few exceptions, will not be built. The Masters projects tend to be independent student projects that promote self-guided research. These projects typically have hypothetical sites, programs, and clients unless the student opts to develop an entry for a competition.

The University of Kansas defined the first two years as foundational years that are focused on developing the individual student.

The first year focuses on abstract exercises that teach the students how to think, see, react, speak, and draw like architects. Projects tend to be small and frequent (15 assignments per semester).

The second year is a transitional year where students are confronted with a building typology at a small to medium scale. The second year sites tend to have real constraints such as sight lines, zoning codes or setbacks, but were described by the faculty as “not actual sites” (KU Focus Group, 2016).

The third year has two distinct parts – a design/build studio with a real client, real site, and real program and an experimental studio that aligns with faculty interests or faculty research. The experimental studio ranges in degree and kind but like the design-build program consists of common curricular elements of: craft, collaboration, and technical documentation. The site, program, client, level of community engagement, and actualization ranges was based upon the selected topic and the faculty. These projects were described as being real.

The fourth year is intended to be group projects with a real client. These studios are either urban design (fall) or integrated studios (spring). The cornerstone attributes of these studios center on the real interactions with clients and consultants (often engineers, planners, or professional architects). These studios are collaborative versus inter-disciplinary.

The fifth year studio is a mix of design-build, health, sports, entrepreneurial, or urban design-related studios. The entrepreneurial studio is interdisciplinary and enables students in architecture to collaborate with students in the College of Business.

There was also general consensus regarding the various curricular pathways through the various NAAB accredited degree programs and the unaccredited TAMU Bachelor of Environmental Design (BED) program. Faculty described this navigable common ground as "starting with theoretical, scale-less, abstract exercises that increase in realness, size, utility, and complexity as the student advances in the curriculum" (KU Focus Group, 2016).

Each of the programs expressed curricular nuances that were particular to their program pedagogy, faculty interests, and faculty research directions. KU faculty described the necessity of real projects for their curricular alignment, "reality is an integral part of what we do here" (KU Focus Group, 2016). In relationship to the knowledge exchange between students and community partners or area professionals, there was general consensus that educating students and the general public through the review process was essential, but not always achievable. Often the outside (community) juror is focused on the final product, while the faculty jurors are focused on the process. As one faculty commented, "our goal as educators is to help students become better designers and to learn what they need to learn for a given project" (UKY Focus Group, 2016). All faculty agreed that inviting local practitioners to the reviews were critical to the success of the students and the vitality of the profession. As one faculty commented, juries are "an opportunity for practitioners to remove themselves from practice, to think and explore ideas" (KU Focus Group, 2016).

Further, several of the faculty expressed how the realness of the project served as an additional motivational force and a connection to opportunities for intellectual property development. "Real world projects provide motivation," "Working with a potential client, whose project is real, can serve as a motivation for students," "My studio uses real life local sites so that the student could read the site and obtain data through practical situational experiences. Whereby enabling the student to keep in mind the realistic aspects of the project," "I often use RFPs for actual public projects as the basis for studio projects. This allows the student to work with a real site, a real program, and a real context that, while hypothetical in terms of an built exercise, is real in that there is an actual site, there is a physical program, and there is a potential client that students need to respond to," and "Most of the projects that I've worked with are real projects and when I see something come good out of the studio, I encourage them (the students) to go for a provisional patent" (TAMU Interviews, 2016).

The qualities of real-ness and hypothetical-ness vary and it appears to be heavily dependent upon community engagement. As articulated by Scott Veazey, "The architect is the quarterback of a community's aspirations" (Personal Communication, 09 February 2016). This is particularly evident in the projects presented by the three programs. However, determining those aspirations often requires students to immerse themselves in an actual site, much like one would immersively learn a foreign language. Professor Shannon Criss at the University of Kansas expressed the necessity of this immersion, "What I am describing is an educational pipeline where a socially aware student feels empowered to create designs, designs that have meaning and matter while providing value to the community. These designs are thoughtful responses to gaps that were revealed by analyzing the context. Often these are gaps that the community was not aware of at the beginning of a project" (Personal Communication, 29 February 2016).

There was consensus amongst the faculty who are leading community-engaged projects that these exercises do add value when working with the community. The faculty emphasized the importance to the architecture curriculum of students working directly with community partners so that student can understand how their input changes the dynamic of the studio and ultimately their project. “Students learn how to absorb feedback from their clients and receive input structural engineers, how to process it, and ultimately how to make sense of that feedback” (KU Interviews, 2016). The range of community involvement varied from working with the community right from the beginning to immersing them in brainstorming sessions to bringing them into the studio for design reviews. Faculty expressed the reciprocal value to both the students and to the community of bringing in community-based stakeholders into the studio. These comments ranged from “I always invite community members to the juries because I feel that it is important for students to face their clients, to educate them, and to learn from them” to “It is important for students to see other people's perspectives and to translate those perspectives in a way that challenges their individual impulse for expression.”

To address the various modes of working in the studio, faculty often bring in internal and external consultants into the studio to work directly with the students. These consultants engage the students, provide specialized knowledge content, and offer general advice as well as constructive criticism that are relevant to the student projects. This process is often repeated at critical stages of a project’s development. During these specialized content workshops, the role of the faculty is to encourage interaction and to facilitate student-to-student or peer-to-peer learning, thus supporting the consensus view of the faculty as being only part of the larger pedagogical vision of the studio curriculum.

There is strong evidence that beyond physical buildings, what the design students are actually building are future partnerships; they are building their self-capacity, they are learning from the site, and they are bringing this knowledge back into the classroom. Thus, they are "translating the classroom into a three-dimensional textbook" (Luhan, 2010).

V.3.4 Change in Self-Efficacy is Influenced by Project Type (PT) and Studio Type (ST)

This hypothesis was tested in three ways: first, using the difference between pre-treatment and post-treatment DSE-M measures and applying multiple regression to regress change in DSE-M on PT and ST; second, DSE-M at time point 1 (pre-treatment) and DSE-M at time point 2 (post-treatment) was used as a response and PT and ST were independent variables; and third, both post-treatment DSE-M and pre-treatment DSE-M were set as independent variables and regressed on PT and ST.

V.3.4.1 Multivariate, Multiple Regression for Complete Cases

A multivariate, multiple regression was completed for each center-by-center and then in combination with TAMU and UKY. In each regression test, the independent variables were identified as studio type (ST) and project type (PT1-PT5) and the dependent variable were change in Design Self-Efficacy (DSE) (DSE1-DSE50) pre-treatment (DSE1-DSE50) and post-treatment for the three theoretical groupings (TG1-TG3).

TAMU had fifty-nine responses for both pre-treatment and post-treatment surveys, of which fifty-nine students have completely answered all of the questions. By looking at the TAMU complete cases through the multivariate, multiple regression analysis, the results are presented in (Table V.17) for TAMU.

UKY had eleven responses for both pre-treatment and post-treatment surveys, of which only three students have completely answered all the questions. It was decided that the sample size was too small to develop a multivariate, multiple regression analysis for complete cases.

V.3.4.2 Multivariate, Multiple Regression for Imputation Cases

The function: mice () in R was used to generate multiple imputations for incomplete multivariate data by Gibbs sampling.

The TAMU results for imputation are provided in (Table V.18) for TAMU.

Due to the high level of missingness, the UKY results can only be considered using imputation. The UKY results for imputation are provided in (Table V.19).

DSE Item	Multi Rsq	AdMulti Rsq	p-value	DSE Item	Multi Rsq	AdMulti Rsq	p-value
DSE_1	0.077	-0.029	0.630	DSE_26	0.026	-0.086	0.963
DSE_2	0.188	0.094	0.081	DSE_27	0.079	-0.028	0.619
DSE_3	0.087	-0.018	0.553	DSE_28	0.056	-0.053	0.798
DSE_4	0.071	-0.036	0.680	DSE_29	0.080	-0.026	0.607
DSE_5	0.104	0.000	0.434	DSE_30	0.072	-0.035	0.669
DSE_6	0.149	0.050	0.192	DSE_31	0.058	-0.051	0.780
DSE_7	0.022	-0.091	0.976	DSE_32	0.143	0.044	0.217
DSE_8	0.123	0.022	0.314	DSE_33	0.071	-0.036	0.677
DSE_9	0.048	-0.062	0.850	DSE_34	0.171	0.075	0.121
DSE_10	0.062	-0.046	0.750	DSE_35	0.137	0.037	0.243
DSE_11	0.026	-0.086	0.964	DSE_36	0.049	-0.061	0.846
DSE_12	0.106	0.003	0.416	DSE_37	0.053	-0.056	0.814
DSE_13	0.063	-0.045	0.742	DSE_38	0.030	-0.082	0.949
DSE_14	0.060	-0.049	0.768	DSE_39	0.033	-0.079	0.938
DSE_15	0.131	0.031	0.272	DSE_40	0.103	0.000	0.437
DSE_16	0.091	-0.014	0.526	DSE_41	0.096	-0.009	0.489
DSE_17	0.061	-0.047	0.757	DSE_42	0.010	-0.104	0.997
DSE_18	0.054	-0.055	0.811	DSE_43	0.010	-0.105	0.998
DSE_19	0.068	-0.040	0.704	DSE_44	0.083	-0.023	0.586
DSE_20	0.046	-0.065	0.866	DSE_45	0.036	-0.075	0.920
DSE_21	0.032	-0.080	0.941	DSE_46	0.058	-0.050	0.777
DSE_22	0.180	0.085	0.099	DSE_47	0.015	-0.098	0.991
DSE_23	0.175	0.079	0.111	DSE_48	0.068	-0.040	0.707
DSE_24	0.064	-0.044	0.732	DSE_49	0.040	-0.070	0.898
DSE_25	0.035	-0.076	0.927	DSE_50	0.040	-0.070	0.898

Table V.17 TAMU Summary of Linear Regression Test for the Influence of ST and PT on Change in SE (Complete Cases)

DSE Item	Multi Rsq	AdMulti Rsq	p-value	DSE Item	Multi Rsq	AdMulti Rsq	p-value
DSE_1	0.077	-0.029	0.630	DSE_26	0.026	-0.086	0.963
DSE_2	0.188	0.094	0.081	DSE_27	0.079	-0.028	0.619
DSE_3	0.087	-0.018	0.553	DSE_28	0.056	-0.053	0.798
DSE_4	0.071	-0.036	0.680	DSE_29	0.080	-0.026	0.607
DSE_5	0.104	0.000	0.434	DSE_30	0.072	-0.035	0.669
DSE_6	0.149	0.050	0.192	DSE_31	0.058	-0.051	0.780
DSE_7	0.022	-0.091	0.976	DSE_32	0.143	0.044	0.217
DSE_8	0.123	0.022	0.314	DSE_33	0.071	-0.036	0.677
DSE_9	0.048	-0.062	0.850	DSE_34	0.171	0.075	0.121
DSE_10	0.062	-0.046	0.750	DSE_35	0.137	0.037	0.243
DSE_11	0.026	-0.086	0.964	DSE_36	0.049	-0.061	0.846
DSE_12	0.106	0.003	0.416	DSE_37	0.053	-0.056	0.814
DSE_13	0.063	-0.045	0.742	DSE_38	0.030	-0.082	0.949
DSE_14	0.060	-0.049	0.768	DSE_39	0.033	-0.079	0.938
DSE_15	0.131	0.031	0.272	DSE_40	0.103	0.000	0.437
DSE_16	0.091	-0.014	0.526	DSE_41	0.096	-0.009	0.489
DSE_17	0.061	-0.047	0.757	DSE_42	0.010	-0.104	0.997
DSE_18	0.054	-0.055	0.811	DSE_43	0.010	-0.105	0.998
DSE_19	0.068	-0.040	0.704	DSE_44	0.083	-0.023	0.586
DSE_20	0.046	-0.065	0.866	DSE_45	0.036	-0.075	0.920
DSE_21	0.032	-0.080	0.941	DSE_46	0.058	-0.050	0.777
DSE_22	0.180	0.085	0.099	DSE_47	0.015	-0.098	0.991
DSE_23	0.175	0.079	0.111	DSE_48	0.068	-0.040	0.707
DSE_24	0.064	-0.044	0.732	DSE_49	0.040	-0.070	0.898
DSE_25	0.035	-0.076	0.927	DSE_50	0.040	-0.070	0.898

Table V.18 TAMU Summary of Linear Regression Test for the Influence of ST and PT on Change in SE (After Imputation)

DSE Item	Multi Rsq	AdMulti Rsq	p-value	DSE Item	Multi Rsq	AdMulti Rsq	p-value
DSE_1	0.861	0.651	0.096	DSE_26	0.449	-0.379	0.761
DSE_2	0.892	0.729	0.061	DSE_27	0.491	-0.272	0.700
DSE_3	0.441	-0.399	0.771	DSE_28	0.656	0.141	0.426
DSE_4	0.278	-0.805	0.932	DSE_29	0.471	-0.323	0.730
DSE_5	0.824	0.560	0.145	DSE_30	0.724	0.311	0.306
DSE_6	0.501	-0.249	0.687	DSE_31	0.763	0.408	0.240
DSE_7	0.485	-0.288	0.710	DSE_32	0.749	0.373	0.263
DSE_8	0.540	-0.150	0.625	DSE_33	0.961	0.903	0.009
DSE_9	0.521	-0.198	0.656	DSE_34	0.693	0.231	0.362
DSE_10	0.459	-0.352	0.746	DSE_35	0.417	-0.458	0.801
DSE_11	0.366	-0.585	0.858	DSE_36	0.728	0.321	0.299
DSE_12	0.443	-0.394	0.769	DSE_37	0.935	0.839	0.023
DSE_13	0.587	-0.033	0.548	DSE_38	0.900	0.750	0.052
DSE_14	0.557	-0.107	0.597	DSE_39	0.813	0.533	0.161
DSE_15	0.568	-0.080	0.579	DSE_40	0.854	0.634	0.105
DSE_16	0.635	0.088	0.464	DSE_41	0.344	-0.640	0.879
DSE_17	0.438	-0.404	0.774	DSE_42	0.707	0.269	0.335
DSE_18	0.693	0.232	0.361	DSE_43	0.664	0.160	0.412
DSE_19	0.627	0.068	0.477	DSE_44	0.762	0.406	0.241
DSE_20	0.518	-0.206	0.661	DSE_45	0.380	-0.550	0.843
DSE_21	0.517	-0.208	0.662	DSE_46	0.615	0.037	0.499
DSE_22	0.618	0.044	0.494	DSE_47	0.589	-0.027	0.544
DSE_23	0.398	-0.506	0.823	DSE_48	0.851	0.628	0.108
DSE_24	0.483	-0.294	0.713	DSE_49	0.417	-0.458	0.801
DSE_25	0.438	-0.405	0.775	DSE_50	0.650	0.125	0.437

Table V.19 UKY Summary of Linear Regression Test for the Influence of ST and PT on Change in SE (After Imputation)

From the tables, it is clear that there are no statistical linear relationships between the degree of change in DSE and the influence of Studio Type (ST) and Project Type (PT) for both TAMU and UKY. However, there is visible differentiation that is apparent in the data that should be examined further in subsequent research with larger sample sizes.

V.3.5 Predisposition for Collaboration (PD) is Correlated to Design Self-Efficacy (DSE), Project Type (PT), and Studio Type (ST)

Both self-efficacy and predispositions for collaboration are critical information that students bring with them to the design studio. Predispositions for collaboration (PD) that correlate to studio type and project type could mean that students either knowingly or unknowingly gravitate to studios and projects that align with their self-concept and therefore provide the students with an opportunity for increase their self-efficacy. This aligns with self-efficacy research summarized by Barry Zimmerman, "self-efficacy measures offer predictive advantages when a task is familiar and can be specified precisely" (Zimmerman, 2000).

Predisposition	Center	mean pre	sd pre	mean post	sd post	d	SD d	P-value	P-adjust
PD1	TAMU	30.3276	6.0688	31.3684	9.7308	-1.0408	1.2181	0.3814	0.7293
	UKY	34.5833	14.3049	28.3571	4.3254	6.2262	2.265	0.0055	0.5249
PD2	TAMU	29.7982	3.8814	30.7632	9.5929	-0.9649	1.124	0.377	0.7293
	UKY	32.2766	14.8305	30.8462	3.3378	1.4304	2.4064	0.5437	0.9838

Table V.20 Summary of TAMU and UKY Predisposition (PD) Measures for Individualism (PD1) and Collectivism (PD2)

Data collection for Predisposition for Collaboration (PD) was collected at two time points during the semester using the DSE survey instrument (Table V.20). The self-reported scores for PD separate into two measures: PD1 – Individualism and PD2 – Collectivism. Both PD1 and PD2 were statistically analyzed for change between the pre-treatment survey and the post-treatment survey responses for each academic level. The analysis was reported with a 95% confidence interval (CI). A visual analysis of the error bars revealed that change in PD was evident in academic levels. U1 reported an increase in PD1 and an increase in PD2. U2 reported an increase in PD1 and a decrease in PD2. U3 reported a decrease in PD1 and an increase in PD2. U4 reported a decrease in PD1 and an increase in PD2. G7 reported a decrease in PD1 and a decrease in PD2.

It is hypothesized that variation in PD 1 and PD2 over the course of the semester is influenced by the context of the design studio (ST) in relation to the manner in which students work either individually or in teams or both individually and in teams as well the content of the studio (PT) in relation to the hypothetical or real nature of the design studio problem. This hypotheses was tested using values for ST and PT that were averaged through data collected from syllabus content analysis for both TAMU and UKY. The mean values for ST and PT are available in (Table V.13 and Table V.14). These values were analyzed both visually and statistically. Visually there is change in DSE both in the DSE items and in the three theoretically groupings. Statistically, change in PD1 and PD2 did not appear to be correlated to ST and PT (Table V.21). The results of these correlations were not statistically significant.

Center	P-value Complete Cases	P-value Imputation Cases
TAMU	0.1421	0.6579
UKY	"NA"	0.3842
BOTH	0.1363	0.9162

Table V.21 Test Correlation of ST and PT with PD

The largest increase in PD1 was reported in U2 (p-value = 0.7941). The largest increase in PD2 was reported in U4 (p-value = 0.6513). The largest decrease in PD1 was reported in G7 (p-value = 0.5148). The largest decrease in PD2 was reported in G7 (p-value = 0.1106). Neither of these reported differences was statistically significant.

V.3.6 Self-Efficacy (SE) is Predictive of Project Score (PS)

Rubrics can be used to align studio learning targets with a formative assessment of student learning outcomes. An analysis of the studio syllabi revealed three potential misalignments with educational literature. The three issues relate: first, to how learning outcomes are presented to the students, second, to how each of the assignments build upon one another, and third, to how the products result in the stated learning objectives. In the syllabi, faculty often provided a list of course objectives or learning outcomes, but often these outcomes are not measurable. In terms of assessing student success there was consensus of the goal of design education: “we are trying to get them (students) to a point of discovery, so that they can advance the work” (UKY Focus Group, 2016). There was also consensus on the value of a clear assessment strategy to understand what prior knowledge that the students are bringing with them into studio. However, there was disagreement on whether or not rubrics were effective measures of creative success. One faculty commented, “Architecture is just messier than the clarity that rubrics are looking for. To me, architecture doesn’t easily fit into a rubric” (KU Focus Group, 2016). Additional comments ranged from rubrics that assess “punctuality, completeness, creativity, innovation, professionalism” to “let’s just say that some faculty are very explicit about the way that they grade, and there are others that are little bit fuzzier” to “like a design competition, the project that breaks all of the rules wins.” Further, it was unclear as to whether or not the students saw the rubric as being of value. One faculty commented, “I used to put all of the excellent through below-average on the syllabus. And it took too many pages. And it turned out the students weren't really using it when I asked them about it” (TAMU Focus Group, 2016).

The number and the function of the assignments and reviews vary from short assignments that establish buy-in for the studio pedagogy or provide a baseline assessment of student skills by faculty to longer term projects that require iteration, feedback, and continual refinement through the testing and calibration of ideas that achieve the best fit of the project during given a specific timeframe in the semester. “Working to deadlines builds a student’s time management skills and gives them a drop-dead date that is similar to professional practice” (UKY Interviews, 2016). When asked how the projects were graded and the students evaluated, there is strong and unanimous consensus that every “faculty member probably does it a little bit differently.” A particularly poignant example was provided by a faculty member who teaches a design-build studio, “Grading design build studios is really challenging . . . I grade them on their efficacy in managing the role that was assigned to them. I grade the studio project as a whole, both in terms of the design phase, research data, and its evaluation. I assess how consistent it is and how well the experiments have been carried through. Then I grade the final built structure. The last component of the grade is student contribution. Student contribution is measured in three ways: from the faculty, from their studio colleagues, and from the student. I provide modifiers to all the students based on my observations of their contributions, as well as their colleagues' observations of their contributions. I then give them an opportunity to also spell out what they think they've contributed to the studio before assigning a final grade" (KU Interviews, 2016). This assessment and grading process is contrasted to a faculty member who is leading a hypothetical studio, "I am less focused on the final result, but rather I place emphasis on the value on student initiative, willingness to learn, and engagement in the studio" (KU Interviews, 2016).

There was unanimous consensus on the recognized need for assessing both the process and the product of the studio. As clearly summarized by a faculty member, "In order to truly celebrate ideas and learning, the process, delivery, and product must be assessed separately" (UKY Interviews, 2016). Faculty characterized the studio artifact as "a semester long discussion on the process of architecture." However, this is contradicted in the formal review where the process is not evident in the presented artifact. As Scott Veazey noted, "all too often in studio reviews and accreditation visits, all that you (a juror) have to assess is the final product and the juror is left "wondering how a student got from the program to what you're seeing in terms of a final product. It's so important for a student to develop the ability to take in information, analyze it, and use it in a broader context of other influences, both internal and external to the project" (Personal Communication, 09 February 2016). As discussed in the interviews, providing the process-driven data could also provide another educational tool to make implicit knowledge, more explicit. "The artifact could and probably should be more empowered. There's nothing stopping a student from putting information on the board as an integral part of their composition to demonstrate how they came to the final resolution. As a faculty member and a juror, I want to see the testing, the inquiry, and the calibration that will explain to me and to their student colleagues why the student made the decisions that they made" (KU Interviews, 2016).

The following themes emerged from the observation of data related to the project-scoring rubric. The rubric should be distributed to the students prior to submission to better align the student artifact to the criteria for assessment. The artifact submission process should be both explicitly intentional with a clear statement of the studio problem and a clear description of how the students resolved these conditions and standardized in relation to the size, format, quality, and explicit conveyance of information. The rubric does not eliminate the jurors or evaluators pre-existing biases, but does provide structure to the scoring of the work.

Measuring the degree of completeness of required content, the quality of the design development, and the clarity of the communication resulted in five different types of outcomes: high in design and high in communication, high in design and low in communication, low in design and high in communication, low in design and low in communication, and various degrees in between. One of the evaluators commented in their post-evaluation interview, "the graphics were well done, but the design did not achieve many of the milestones" (Evaluator Interviews, 2016). There was unanimous consensus that the presentations should be more intentional and that the artifact "should present the project, explain the problem, and be able to stand by itself" (Evaluator Interviews, 2016). One of the reviewers commented, "the artifact did not reflect all of the aspects that were included in the rubric," while another reviewer stated, "often the rubric was more sophisticated than some of the projects that were being reviewed"

(Evaluator Interviews, 2016). The stated expectations of the rubric could increase the analytical validity of the instrument by making the explicit categories available to the students so that they "include all aspects of the rubric in their presentations" (Evaluator Interviews, 2016). This issue could be addressed by working with the faculty to align the purpose and the objective of the rubric with the course assessment and by distributing the rubric to the students at the beginning of the semester and again, well in advance of the submission.

Using the rubric however does not eliminate pre-existing juror bias and means of assessment; there is a shift from interpretation of outcomes to the recognition of traits that facilitated the scoring of the outcomes (Delandshere & Petrosky, 1998). Several reviewers commented, "I used the rubric to find evidence. I then aligned it with my professional expertise and then I reread the rubric several times before making the determination of scores" (Evaluator Interviews, 2016).

As a further means of validity and reliability, the AQUA software was used to facilitate the scoring of student artifacts and their alignment to the developed rubric. To further assess this issue the scores from multiple reviewers was averaged and compared to determine the level of inter-rater agreement amongst the various reviewers using AQUA's inter-rater reliability and scoring pattern tool. Given the limited number of projects to score, a definitive conclusion was not possible.

V.3.7 There is Correlation Between Demographics and Self–Efficacy (SE)

An analysis of the data gathered related to the demographics of the students who participated in the Design Self-Efficacy (DSE) survey revealed interesting trends pertaining gender and race and ethnicity. Demographics pertaining to gender were statistically analyzed using a t-test and one-way ANOVA to determine statistically significant differences or trends in the data. As follows is a discussion of the findings.

V.3.7.1 Demographics-Gender

Demographics in relation to gender (n=179; F=97 and M=82) were studied both individually per DSE-M item and collectively within the three Theoretical Groupings.

When studied individually 16% of the DSE-M items were shown to have statistical significance with males reporting higher Design Self-Efficacy than females. These eight items include: *DSE_18 - Create technically clear drawings* (p-value = 0.0042), *DSE_21 - Demonstrate the mechanics and material behavior related to building structures through drawings, details, and structural analysis* (p-value = 0.0021), *DSE_27 - Make design decisions in complex projects while considering the variety of influences (e.g., accessibility, environmental systems, structural systems)* (p-value = 0.0015), *DSE_29 - Respond to specific site characteristics in my designs* (p-value = 0.0081), *DSE_30 - Determine the applicable building code, occupancy group(s), and construction type* (p-value = 0.0065), *DSE_33 - Establish points of exit* (p-value = 0.0010), *DSE_34 - Check egress paths for travel distance* (p-value = 0.0058), and *DSE_35 - Determine fixture counts* (p-value = 0.0063).

There were also 28% of the DSE-M items that revealed visual differences that were not reported to be statistically significant. These fourteen items include: *DSE_11 - Translate what I see in precedents to develop a range of solutions* (p-value = 0.0455), *DSE_14 - Use formal, organization, and environmental principles to inform my design* (p-value = 0.0382), *DSE_15 - Apply the fundamentals of ordering systems to natural and formal ordering systems* (p-value = 0.0425), *DSE_22 - Utilize the principles of environmental systems to develop designs for an environmentally responsive building for a given geographic region* (p-value = 0.0408), *DSE_23 - Identify the design problem* (p-value = 0.0485), *DSE_24 - Set evaluative criteria for possible designs* (p-value = 0.0127), *DSE_25 - Analyze designs using set criteria* (p-value = 0.0414), *DSE_26 - Predict the effectiveness of a design if implemented* (p-value = 0.0432), *DSE_31 - Determine allowable area and height* (p-value = 0.0454), *DSE_32 - Calculate occupant load* (p-value = 0.0271), *DSE_43 - Use design terminology correctly* (p-value = 0.0471), *DSE_45 - Persuade my audience of why my concept is appropriate for the design problem I was given* (p-value = 0.0162), *DSE_46 - Make my audience believe I am a credible designer* (p-value = 0.0195), and *DSE_48 - Appear confident* (p-value = 0.0160).

In this subchapter, I will analyze gender demographics (n=179; F=97 and M=82) collectively using the three theoretical groupings: 1) ability to evolve an idea in response to site constraints, program requirements, and structure that result in a meaningful solution, 2) the ability to develop the idea in architectural terms, and 3) the ability to present the idea in drawings or models" (Caragonne, 1995). When studied collectively, Theoretical Group 2 was shown to have statistical significance (p-value = 0.0016), whereas Theoretical Group 1 (p-value = 0.0462) and Theoretical Group 3 (p-value = 0.0265) were shown to have visual significance.

Given the relatively small sample size (n=179; F=97 and M=82), it is not possible to arrive a definitive conclusion. However, given the results of the data there seem to be an emergent trend that would be of value for further study and future research related to gender in architectural design studios. Using the statistical significance of 16% and the visual significance 28% of the DSE-M items as a guide to reveal trends, the twenty-items fall into three categories: Design Principles and Evaluation, Health, Safety, and Welfare; and Confidence. These topics align with the faculty consensus comments that emerged from qualitative data – focus groups and interviews related to a strengthening of design principles, a value alignment of health, safety, and welfare issues, and the role of faculty in building student confidence through mentoring and clear outline of learning objectives. These criteria also point to a need to study models for inclusive educational models that align project complexity with motivational techniques for ensuring confidence in all students.

V.3.7.2 Demographics-Race/Ethnicity

Demographics in relation to Race/Ethnicity (n=185, White or Caucasian = 104, Hispanic or Latino = 36, African-American = 6, Multi-Racial = 8, International = 22, Asian = 3, Declined to Respond = 6) were studied collectively within the three Theoretical Groupings. These demographics were statistically analyzed using One-way ANOVA and Means Comparisons for each pair using Student's t. The confidence interval for the analysis is 95% (alpha = 0.05). Using both statistical and visual significance as a guide for analysis the following observations are presented. In analyzing Theoretical Group 1: Asians reported the highest mean value = 83.397, White or Caucasian reported a mean value of 76.621, and African-Americans reported the lowest mean value = 74.620. In analysis of the Ordered difference Report for Theoretical Group 1 when comparing Asians to African-Americans (p-value = 0.04389) and Multi-Racial to African-Americans (p-value = 0.0457) there appears to be visual difference but not statistical differences between these groups. In analyzing Theoretical Group 2: Asians and International students reported the highest mean value = 86.898 and 80.885 respectively, White or Caucasian reported a mean value of 67.018, and African-Americans reported the lowest mean value = 62.247. In analysis of the Ordered difference Report for Theoretical Group 1 when comparing International to Latino (p-value = 0.0430) and International to White or Caucasian (p-value = 0.0344) there appears to be visual difference but not statistical differences between these groups. In analyzing Theoretical Group 3, there is no visual or statistical difference to report.

Given the limited number of projects to score, claims cannot be made beyond this study as relates to demographics and Design Self-Efficacy. While, demographic information pertaining to education classification, gender, age, Pell-eligibility, and race/ethnicity was collected from students who participated in the study, due to the small sample size, demographics of the artifacts do not align with the goals of the project scoring. Therefore it was not possible to measure student performance or to easily filter results by demographics. Given the small sample size, it is not possible to formulate any generalizable conclusions, especially related to various demographics (e.g., program, course, class level, gender).

V.4 Summary of Data Analysis

The data analysis revealed that the multi-dimensionality of the NAAB SPC could be translated into an instrument that could measure Design Self-Efficacy (DSE) in the context of architectural design studios. The data analysis revealed an alignment between the self-reported outcomes of the Design Self-Efficacy (DSE) measurement instrument and self-efficacy theory. Further, it revealed that aligning the NAAB criteria to best practices of educational assessment requires clear, explicit, and measurable student learning outcomes in order for evidence to be effectively measured. This could impact design pedagogy and positively inform the evaluation of evidence in the design studio. The highest reported DSE-M measures related to project communication, the moderately reported DSE-M measures related to project development, iteration, and evaluation, and the lowest reported DSE-M measures related to the topics of Health, Safety, and Welfare (HSW). This points to the possible use of the DSE instrument as an effective heuristic for aligning knowledge of DSE scores with the nimbleness of the faculty to address opportunities to respond to these gaps and facilitate student learning.

CHAPTER VI

CONCLUSIONS AND FUTURE RESEARCH

The previous chapters have developed a logical structure to support the outcomes of this research. Chapter I introduced the project and presented key research questions. Chapter II presented a *Review of Literature* that explored architectural design education (studio pedagogy, studio typology, and project typology), self-efficacy, collaboration, and project scoring (for assessing creativity). Chapter III presented the *Research Methodologies* that led to the selection of the methods used to test the hypotheses in this research. It described the development of various instruments and their validation and calibration. It presented the research instrumentation including the self-efficacy survey, syllabi content analysis, focus groups, interviews with faculty, rubric development, and project review and assessment. This chapter also discussed the assumptions, limitations, and delimitations of the research. Chapter IV presented the *Data and Observations* summary of the data collected in the research, the descriptive analysis techniques, and instruments used in the hypotheses testing, arguments for reliability and validity of the research design, and the inter-rater reliability measures of the project scoring. This chapter concluded with a summary of the data and observations that informed the analysis of the data. Chapter V presented the *Data Analysis* and outlined the contributions and claims and supports each with facts drawn from the analysis.

This chapter discusses the main findings, implications, and contribution of the study and outlines areas of *Future Research* beyond the dissertation. This research builds upon the professional accreditation standards outlined by the National Architectural Accrediting Board (NAAB) and brings rigor and structure to the design studio. Within this framework, the dissertation incorporated a mixed method research design to produce several findings.

VI.1 Summary of Discoveries

This research has produced six significant original contributions: 1) an instrument for measuring self-efficacy domain mastery skills in architectural design studios, 2) an instrument for measuring project score and student success, 3) categorization of studio type and project type, 4) an understanding of the predictive value of a student's predisposition for collaboration, 5) disciplinary insights into architectural design studio education, and 6) correlation between Design Self-Efficacy and Demographics related to Gender, Race and Ethnicity.

VI.1.1 Contribution One: An Instrument for Measuring Self-Efficacy Domain Mastery Skills in Architectural Design Studios

This research included the scale creation and validation for the Design Self-Efficacy (DSE) instrument. The scale and subscales were established by deriving DSE Mastery (DSE-M) items from the 2014 National Architectural Accreditation Board (NAAB) Student Performance Criteria (SPC) that are required for all professionally accredited programs of architecture. The constructed DSE measurement instrument contains fifty items that translate the twenty-six SPC into self-reported, operational *I can do* statements. In trial surveys with a sample of architecture students, the instrument produced meaningful results that are consistent with self-efficacy literature and theory as well as design pedagogy as characterized from a review of literature and theory. This suggests that the instrument is valid. Based upon the data that was gathered in this project, the instrument has demonstrated sensitivity, which is an underlying condition of establishing internal consistency and reliability.

The instrument was used in programs of architecture of three institutions, Texas A&M University (TAMU), the University of Kentucky (UKY), and the University of Kansas (KU), to understand generalizability of the DSE instrument across NAAB accredited professional programs of architecture. Students participated in the online survey at two time points over the course of the semester, time point one, at the beginning of the semester and time point two, at or about final review. During the first time point, at the beginning of the semester, two hundred sixty-two students – Freshman (U1), Sophomore (U2), Junior (U3), Senior (U4), and Graduate (G7) at TAMU, UKY, and KU who were enrolled in architectural design studios completed the survey (n=262). Since KU did not complete the second survey, the data collected as the second timepoint DSE-M measurements only include students responses from TAMU and UKY. During the second time point, at the end of the semester, one hundred students completed the survey (n=100).

A homogeneity test about covariance to DSE measures was performed to see if the center populations of TAMU, UKY, and KU share a common covariance matrix. This analysis used the test statistics T2 to test the equality of several covariance matrices with fewer observations than the dimension included in the survey (Srivastava and Yanagihara, 2010). The result of the homogeneity test rejected the null hypothesis: T 2 =

11.0632 with a p-value = 0.004036 demonstrated that the covariance was not equal. Therefore, the three institutions: TAMU, UKY, and KU have different covariance matrix for DSE measures could not be pooled as one dataset and required separate analyses.

Despite the lack of homogeneity, there was parity among all three institutions for the baseline DSE-M measure with: 28% of the DSE average mean values reported high Design Self-Efficacy Mastery (in the 80-89 range), 60% of the DSE-M average mean values reported moderate Design Self-Efficacy Mastery (in the 70-79 range) and 12% of the DSE-M average means values reported low Design Self-Efficacy Mastery (in the 50-69 range). In addition, there was parity among all three institutions for the DSE measurements with: 18% of the DSE-M average mean values reported high values (in the 80-89 range), 62% of the DSE-M average mean values reported moderate values (in the 70-79 range) and 20% of the DSE-M average means values reported low values (in the 50-69 range).

The DSE-M items that students perceived as high self-efficacy as both baseline and post-treatment measures reflect the items that are most relevant to graphic communication of a design solution. When analyzed within self-efficacy theory, the possible reasons why these scores may have been reported higher than the others could relate to a student's previous success in presenting their materials in process notebooks, studio portfolios, desk crits, informal design reviews, and formal design reviews, a student's familiarity with the design presentation process, and a student's increased value on presenting their design work.

The DSE-M items that students perceived as low self-efficacy as both baseline and post-treatment measures reflect the items that are most relevant to the realness of a project such as criteria such as the Health, Safety, and Welfare of a design solution that are central requirements for passing the Architectural Registration Examination (NCARB, 2015). When analyzed within self-efficacy theory, the possible reasons why these scores may been reported lower than the others could relate to a students' lack of previous success in relation to the subject matter, a lack of perceived value in relation to the task, a lack of knowledge of the subject matter or unfamiliarity with the task, or the information was new to the student.

The analysis of the survey data also revealed groupings that are consistent with architectural theory and the processes of design studio problem-solving, project development, iteration, evaluation, and communication.

The created DSE instrument was useful in increasing the understanding of the influence of studio type, project type, and predispositions for collaboration on Design Self-Efficacy and enabled a rigorous evaluation both per item and in theoretical groupings across all academic levels.

As an extension of this research contribution DSE Mastery will be studied longitudinally, across a longer span of time, from first year undergraduate through successful completion of the National Council of Architectural Registration Boards (NCARB) Architectural Experience Program (AXP). The range of time will ensure that students and graduates of accredited programs have the knowledge, skills, and Design Self-Efficacy that is required for independent professional practice.

VI.1.2 Contribution Two: An Instrument for Measuring Project Score and Student Success in Architectural Design Studios

This research included the scale creation and validation for an instrument that measures project score and student success. Comparing and assessing the products of creative design is often elusive. As noted by Lueth, instructors should develop explicit rubrics and assess students on how they accomplish the goals of the studio (Lueth, 2008). Literature also supports the equal weighting or valuing of both the process and product of architectural design solutions. Given that assessing achievement by an architecture student is typically done through informal and formal public presentations, the challenge undertaken by this research project focused upon determining which features and outcomes need to be assessed, especially if the reviewer of the work only has the finished artifact to review.

The iterative process of the design studio investigation often results in an end product that has been vetted both inside and outside of the studio environment. As Scott Veazey, the President of the National Architectural Accrediting Board (NAAB) noted, "all too often in studio reviews and accreditation visits, all that you (a juror) have to assess is the final product and the juror is left "wondering how a student got from the program to what you're seeing in terms of a final product. It's so important for a student to develop the ability to take in information, analyze it, and use it in a broader context of other influences, both internal and external to the project" (Personal Communication, 09 February 2016). Architectural design competition review and selection process were used to provide some insights into effective measures of artifact-only review (Thompson, 2002).

A project scoring rubric derived from a factor analysis of NAAB SPC criteria and triangulated between syllabi content analysis, coding of faculty focus groups and interviews was developed and tested in conformance with rubric best practices for this research project. Project Scoring rubric was tested on a small sample of student artifacts and utilized by a cadre of evaluators. These evaluators were interviewed after using the rubric to complete their scoring. These interviews provided additional insights that demonstrate how this rubric can be used in studio curriculum.

The results of the Project Score (PS) were consistent with the analysis of the DSE-M measurement. In the DSE-M measurement, students reported higher Design Self-Efficacy pertaining to Graphic and Visual Communication Presentation skills and lower Design Self-Efficacy pertaining to Data Evaluation and Integrative Learning. In the Project Scoring rubric, student scores were also reported higher and with less variance in relation to Graphic and Visual Communication Presentation skills and lower scores with more variance in relation to Design Iteration and Data Evaluation which include topics related to Health, Safety, and Welfare.

Building from this research, it is now possible to undertake additional studies that calibrate the rubric to measure student learning objectives across programs so that it may be transferable to all NAAB accredited programs.

VI.1.3 Contribution Three: Categorization of Studio Type and Project Type in Architectural Design Studios

Building from Lueth, this research also categorizes studio type and project type to describe the method and means for developing the requisite skills, knowledge, and expertise to produce architectural solutions at a variety of scales. This categorization was described in faculty focus groups and interviews as way of gauging the influence of the various modes of working in the design studio (individually, both individually and in teams, or in teams) and the types of projects that students address. By understanding these characteristics, it is possible to link the outcomes of the student work to measurable learning outcomes that can be evaluated by using an assessment rubric that result in a project score.

This contribution uses data from three sources: student and faculty self-reporting, faculty focus groups and interviews, and syllabi content analysis. These sources provide additional understanding to the inner workings of the design studio both in terms of the context and the content of interaction between students. This contribution was analyzed first visually and then statistically. The visual assessment of the impact of ST and PT are clearly visible, however; the statistical analysis was statistically inconclusive. For future research, ST and PT will continue to be examined across a larger sample size in order to draw statistically significant conclusions.

VI.1.4 Contribution Four: An Understanding of the Predictive Value of a Student's Predisposition for Collaboration in Architectural Design Studios

An existing measurement instrument used to understand a student's individualism and collectivism has been applied to the architectural design studio. This validated and reliable instrument has shown sensitivity and predictive value of Predispositions to Collaboration to Design Self-Efficacy.

Both self-efficacy and predispositions for collaboration are critical information that students bring with them to the design studio. Predispositions for collaboration (PD) that correlate to studio type and project type could mean that students either knowingly or unknowingly gravitate to studios and projects that align with their self-concept and therefore provide the students with an opportunity for increase their self-efficacy.

For future research, it will be beneficial to develop a research design that requires a pre-test of PD for students who will enroll is design studios. The results of the PD test could be used to determine the allocation of design studios across ST and PT to more effectively assess the influence of PD on ST and PT and vice-versa.

VI.1.5 Contribution Five: Insights into Architectural Design Studio Education

Architectural education has long relied upon the design studio course to convey professional competence and behavior; however, rigorous research to determine whether those educational methods are truly effective is rare. The content analysis of the syllabi and the comparison of data to recommended practices of assessment have revealed gaps in the rigorous evaluation, both in terms of process and product, in architectural design studios. An analysis of the studio syllabi revealed three potential misalignments with educational literature.

The three issues relate:

1. To how learning outcomes are presented to the students
2. To how each of the assignments build upon one another
3. To how the products result in the stated learning objectives

This research study provided evidence about teaching methods, the design teaching profession, and the role of the design studio review. The pedagogical implications include:

1. Aligning curricular learning objectives that reinforce the knowledge exchange between the faculty and student thus adding perceived value that positively reinforces a student's perceptions of the subject matter content,
2. Leveraging the NAAB designations of understanding or ability, so that the program curriculum and allied studio courses build upon one another and strategically reinforce concepts and tasks so that a student's confidence in the capabilities develops throughout the curriculum, and
3. Engaging in real projects where these real criteria need to be addressed in the realization or simulation of a project.

VI.1.6 Contribution Six: Correlation Exists Between Design Self-Efficacy and Demographics Related to Gender, Race and Ethnicity in Architectural Design Studios

The data gathered in this study has provided insights to the differences among gender groups and race/ethnicity groups with respect to design self-efficacy. Demographics were analyzed in relation to gender (n=179; F=97 and M=82) and revealed that men tend to have higher DSE-M than women. When, studied individually per DSE-M item, 16% or 8 of the 50 DSE-M items were shown to have statistical significance. The items that reported statistical significance include:

DSE_18 - Create technically clear drawings (p-value = 0.0042)

DSE_21 - Demonstrate the mechanics and material behavior related to building structures through drawings, details, and structural analysis (p-value = 0.0021)

DSE_27 - Make design decisions in complex projects while considering the variety of influences (e.g., accessibility, environmental systems, structural systems) (p-value = 0.0015)

DSE_29 - Respond to specific site characteristics in my designs (p-value = 0.0081)

DSE_30 - Determine the applicable building code, occupancy group(s), and construction type (p-value = 0.0065)

DSE_33 - Establish points of exit (p-value = 0.0010)

DSE_34 - Check egress paths for travel distance (p-value = 0.0058)

DSE_35 - Determine fixture counts (p-value = 0.0063)

Given the relatively small sample size (n=179; F=97 and M=82), it is not possible to arrive at a definitive conclusion. However, given the results of the data there seem to be an emergent trend that would be of value for further study and future research related to gender in architectural design studios. Using the statistical significance of 16% and the visual significance 28% of the DSE-M items as a guide to reveal trends, the twenty-items fall into three categories:

1. Design Principles and Evaluation
2. Health, Safety, and Welfare
3. Confidence

The demographics of the design studios were also analyzed in relation to Race/Ethnicity (n=185). These numbers were reported as: White or Caucasian (n = 104); Hispanic or Latino (n = 36); African-American (n = 6); Multi-Racial (n = 8); International (n = 22); Asian (n = 3); and Declined to Respond (n = 6). In analyzing Theoretical Group 1: Asians reported the highest mean value = 83.397, White or Caucasian reported a mean value of 76.621, and African-Americans reported the lowest mean value = 74.620. In analysis of the Ordered difference Report for Theoretical Group 1: When comparing Asians to African-Americans (p-value = 0.04389) and Multi-Racial to African-Americans (p-value = 0.0457) there appears to be visual difference but not statistical differences between these groups. In analyzing Theoretical Group 2: Asians and International students reported the highest mean value = 86.898 and 80.885 respectively, White or Caucasian reported a mean value of 67.018, and African-Americans reported the lowest mean value = 62.247. In analysis of the Ordered difference Report for Theoretical Group 1 when comparing International to Latino (p-value = 0.0430) and International to White or Caucasian (p-value = 0.0344) there appears to be visual difference but not statistical differences between these groups. In analyzing Theoretical Group 3: There is no visual or statistical difference to report.

These observations will require additional studies over a larger period of time and a larger sample size in order to draw statistically significant conclusions.

VI.2 Summary of Conclusions

This dissertation contributes to the academic and professional community by expanding the existing body of knowledge in three areas: academic theory, academic practice, and professional practice praxis. An understanding of the relationship between teaching methods and their link to self-efficacy and learning outcomes can improve design education. Pedagogy in design studios can incorporate this psychometrically sound instrument to detect architectural self-efficacy. This research contributes to literature on integrated studio curriculum, collaboration, and self-efficacy in project-based inquiry. The results of this investigation could also influence other disciplines that use project-based inquiry.

This research has produced multiple measurement instruments for design education that provides a holistic diagnostic for identifying both educational efficiencies and deficiencies in architectural design studios. These instruments inform an impactful, market-responsive, individualized learning program that directly benefits society and informs academic pedagogy. The measurement instrumentation could be disseminated to other institutions and provide a more generalized understanding of design studios while promoting parallel assessment for other courses. Demographic insights gained by this study could align with a deeper understanding of how to better serve under-represented groups. Knowledge gained by this research could impact curriculum for outreach projects that promote community engagement, problem solving, and inform emerging models of practice.

VI.3 Future Research

The results of this dissertation serve as a foundation for an agenda for future research to improve design education, the accreditation process of professional architecture programs in North America and by extension, the practice of architecture.

This research could lead to a rigorous 21st century model of design education, the development of a new model syllabus for an interdisciplinary, integrated design studio collaboration with explicit and measurable student learning outcomes, objectives, and a well-defined assessment rubric. The ultimate extension would be the development and dissemination of a new curriculum pattern. This research could formulate and validate a model for effective design pedagogy that would bring many disciplines together to tackle complex design problems related to the built environment. It is hypothesized that it is possible to develop an innovation-driven pedagogical framework that increases self-efficacy in the context of interdisciplinary, collaborative, integrated design studios. This pedagogical model could then be used to assess a range of quasi-real academic projects spanning from the theoretical to design-build to community-engaged projects.

The possible extension that may result from the findings of these research investigations includes the adoption of the developed measurement instrument across design programs. The research results could be further translated as a framework for parallel assessment for other courses across the Texas A&M University, the University of Kentucky, the University of Kansas, and beyond. As part of a longer-term longitudinal study, opportunities to extend the dissertation beyond the academy can further validate the data developed during the study. As part of this extension, research could rely upon an expert panel where a range of design firms that have hired students measured the longitudinal study are interviewed to identify the graduates who are the most collaborative or the least collaborative performers.

Beyond the discipline of architecture, the research could have significance to many and perhaps all other disciplines: engineering, medicine, law, science, and the humanities.

The DSE instrument provided an inclusive characterization of the learning objectives associated with completing the educational objectives for architectural education that are germane to design studios. This instrument is applicable to all NAAB accredited programs and could change the assessment of architectural design studio education and the evaluation of evidences in student artifacts. This process would need to be tested on a larger sample size and across multiple institutions.

This paragraph discusses the refinement of the instrument for future research. Self-efficacy was measured using the DSE instrument at two points during the semester. Given the large number of items, fifty, it was expected that the Cronbach's alpha score would be high. The Cronbach's alpha for the entire DSE instrument was $\alpha = .9829$. Acceptable values of Cronbach's alpha typically range from 0.70 to 0.95. A maximum alpha value of 0.90 has been recommended (Tavakol & Dennick, 2011). If the alpha is above this level, it may indicate that some items are redundant as they may be testing the same question but under a different pretense, revealing that the test length should be shortened. After determining the relationships between the NAAB SPC and the DSE questions, a canonical correlation analysis was performed to test for highly inter-correlated items and an analysis of variance (ANOVA). This process was completed for each of the time points to determine if any of items could be reduced to refine the instrument for future research. For this validation exercise, a cutoff of .5 or below was identified as non-correlated items. For the ANOVA, a p-value threshold was set for <0.001 to determine if the question responses had a statistically significant variation of responses. P-values were determined by both individual item and as part of theoretical group.

Using the P-value <0.001 as a guide the following seven items could be removed from the instrument for future research to reduce the number of items in the instrument:

- *DSE_2 - Use effective oral communication that is appropriate for the general public* (pre-treatment survey p-value =0.0159, post-treatment survey p-value = 0.0786),
- *DSE_4 - Write effectively for the general public* (pre-treatment survey p-value = 0.0296, post-treatment survey p-value = 0.0264),

- *DSE_7 - Gather information relevant to a project* (pre-treatment survey p-value = 0.1043, post-treatment survey p-value = 0.0528),
- *DSE_9 - Thoroughly analyze the precedents I chose for a project* (pre-treatment survey p-value = 0.0016, post-treatment survey p-value = 0.0855),
- *DSE_10 - Connect my precedents to the design project I am completing* (pre-treatment survey p-value = 0.0229, post-treatment survey p-value = 0.0209),
- *DSE_12 - Critically evaluate my iterations* (pre-treatment survey p-value = 0.0495, post-treatment survey p-value = 0.0205), and
- *DSE_38 - Respond to questions without being defensive* (pre-treatment survey p-value = 0.5812, post-treatment survey p-value = 0.0862).

Furthermore, an additional eleven items need additional study to determine if they can be removed from the instrument for future research as the reported p-value results were close to the p-value <0.001 threshold. These items include:

- *DSE_6 - Use representational media (e.g., models, drawings) that is appropriate for the general public* (pre-treatment survey p-value = 0.0014, post-treatment survey p-value = 0.0049),
- *DSE_11 - Translate what I see in precedents to develop a range of solutions* (pre-treatment survey p-value = 0.0001, post-treatment survey p-value = 0.0378),
- *DSE_20 - Construct models that illustrate and identify all necessary information for a building design* (pre-treatment survey p-value = 0.0024, post-treatment survey p-value = 0.0052),

- *DSE_21 - Demonstrate the mechanics and material behavior related to building structures through drawings, details, and structural analysis* (pre-treatment survey p-value = 0.0001, post-treatment survey p-value = 0.0123),
- *DSE_23 - Identify the design problem* (pre-treatment survey p-value = 0.0001, post-treatment survey p-value = 0.0536),
- *DSE_29 - Respond to specific site characteristics in my designs* (pre-treatment survey p-value = 0.0001, post-treatment survey p-value = 0.0077),
- *DSE_36 - Talk about specific parts of my drawings, models, and other visuals* (pre-treatment survey p-value = 0.0035, post-treatment survey p-value = 0.0008),
- *DSE_40 - Explain my design process from start to finish* (pre-treatment survey p-value = 0.0392, post-treatment survey p-value = 0.001),
- *DSE_41 - Describe the design problem that was given to me* (pre-treatment survey p-value = 0.0177, post-treatment survey p-value = 0.0014),
- *DSE_42 - Show the connection between my original concept and my final design* (pre-treatment survey p-value = 0.1031, post-treatment survey p-value = 0.0043), and
- *DSE_45 - Persuade my audience of why my concept is appropriate for the design problem I was given* (pre-treatment survey p-value = 0.0066 post-treatment survey p-value = 0.0040).

The measurement of self-efficacy may be a key to improving pedagogical methods to reach more focused learning outcomes in not only architectural education but, many other disciplines.

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APPENDIX 01

TAMU, UKY, AND UKY STUDIO CULTURE POLICIES

Studio Culture at Texas A&M University

All students, faculty, administration, and staff of the Department of Architecture at Texas A&M University are dedicated to the principle that the Design Studio is the central component of an effective education in architecture.

They are equally dedicated to the belief that students and faculty must lead balanced lives and use time wisely, including time outside the design studio, to gain from all aspects of a university education and world experiences. They also believe that design is the integration of many parts, that process is as important as product, and that the act of design and of professional practice is inherently interdisciplinary, requiring active and respectful collaboration with others.

Operational Procedure

Students and faculty in every design studio will embody the fundamental values of optimism, respect, sharing, engagement, and innovation. Every design studio will therefore encourage the rigorous exploration of ideas, diverse viewpoints, and the integration of all aspects of architecture (practical, theoretical, scientific, spiritual, and artistic), by providing a safe and supportive environment for thoughtful innovation. Every design studio will increase skills in professional communication, through drawing, modeling, writing, and speaking.

Every design studio will, as part of the syllabus introduced at the start of each class, include a clear statement on time management, and recognition of the critical importance of academic and personal growth, inside and outside the studio environment. As such it will be expected that faculty members and students devote quality time to studio activities, while respecting the need to attend to the broad spectrum of the academic life.

Every design studio will establish opportunities for timely and effective review of both process and products. Studio reviews will include student and faculty peer review. Where external reviewers are introduced, the design studio instructor will ensure that the visitors are aware of the Studio Culture Statement and recognize that the design critique is an integral part of the learning experience.

The design studio will be recognized as place for open communication and movement, while respecting the needs of others, and of the facilities.

University of Kentucky, College of Design - Studio Culture Policy

(Revised August 21, 2012)

Goals

- Evaluate conventional studio culture and address areas of success and failure. Suggest ways to improve efficiency and student behavior in the studio environment.
- Define the academic relationship between students and instructors to ensure a fair, efficient and creative environment.
- Suggest practices for instructors regarding the curriculum and grading to avoid ambiguity and misunderstanding between instructors and students.
- Encourage interdisciplinary collaboration and student/instructor cooperation within and outside of the studio environment.
- Define the responsibility of the college in supporting the Studio Culture Policy to ensure a rich and dynamic design environment.

Criticism of Conventional Studio Culture

- Students must learn to balance their time in order to ensure their best performance and maintain their health and well-being.
- "All-nighters" are counter-productive and should not be encouraged. Instead, the studio culture should promote good time management skills.
- Columbia specifies the hours in which students are allowed to be in studio; students cannot be in studio outside the specified time period. This model levels the playing field for all students: those who are on full rides and therefore do not

have to work and those who must work to support themselves and, in some cases, their families.

- While studio requires more dedication and time than other classes with fewer credit hours, the professor should recognize the importance of other classes in reaching the overall goal of achieving a well-rounded and complete post-secondary education.
- Students should maintain rigorous yet manageable workloads in order to have a successful college experience.

Students and Instructors

- Effective communication, cooperation, and mutual respect are all crucial components of the Student-Instructor dynamic. Both parties should be held accountable for their respective involvement in the studio process and the final product.
- Professors should emphasize the studio experience as a process towards a final goal rather than placing emphasis on a single product.
- Students and professors must recognize that design is a subjective discipline. There is no right answer within the studio culture. While students should listen to and respect a professor's opinions, professors should also understand that studio is a place for students not only to develop technical skills, but also to figure out who they are as designers. There should exist a careful balance to ensure that the student is producing individualized and unique work.

- This is especially true for graduate level studio, where students have a stronger sense of who they are as a designer.
- Students are not subordinates. Professors should recognize the distinction between design work and grunt work
- Instructors should stress the critical importance of cataloguing work and preparing studio work for the student's portfolio. In addition, instructors should make themselves available to provide advice concerning careers and further education.

Curriculum and Evaluation

- Professors should be held responsible for clearly communicating expectations for a studio, especially those concerning the incremental process that takes place throughout the semester and the end goal. They should also provide students with clear criteria regarding grading. This is to prevent misunderstanding and conflicts if a student feels that he/she has received a grade that does not reflect performance.
- Professors should provide direct and well thought out plans for their studios to ensure good time management on the part of the students. Without these plans, the students cannot possibly manage their time in a successful way.
- Dates for reviews and major deliverables should be clearly outlined in the professor's syllabus distributed at the beginning of the semester.
- Professors should emphasize the importance of writing and encourage the use of appropriate language in communicating ideas.

- Design students excel at graphic representation of projects, but their writing abilities are often not as strong. A sharper focus on the ability to describe projects clearly and effectively in writing would be a great benefit to students once they set out into the professional world.
- Professors should consider a student’s performance over an entire in determining the student’s final grade. Explanations, with clear and distinct reasoning, are necessary to explain the professor’s evaluation of the student’s performance.
- Midterm grades should be given in the same manner as final grades. "Blanket grades" or placeholders are not helpful to student's progress or final product. According to university policy, midterm grades are not required for graduate students but must be given to undergraduate students. In the past our college has not enforced these policies.
- Professors should push students to reach their greatest potential. This includes the issue of leniency. If it is impossible to fail, students will not be properly prepared for the professional world. Professors should hold students accountable for their work.

Collaboration and Competition

- Collaboration should be highly encouraged at all levels in the College and outside: between individual students, studio years, and with other universities.
- The studio environment is both cooperative and competitive. Students learn immeasurably from their peers through mutual support and healthy competition. Professors should promote a studio environment that includes both.

- Students should be encouraged to sit on reviews of their peers. Interaction to bridge the gap between undergraduate and graduate programs should be promoted.
- Collaboration between studio years should be encouraged at all times. Upper-level students have as much to contribute to lower years as their respective professors.
- The College should encourage the inclusion of interdisciplinary faculty, and/or partnerships with other disciplines such as engineering, business, product design, art, and landscape architecture.
- Students are encouraged to take on competitions and responsibilities in extracurricular activities whenever possible.

The College and Studio Culture

- The College should seek to maintain a fresh and contemporary approach towards design education and provide opportunities for involvement outside the university.
- New faculty should be added regularly to the College and existing faculty should be encouraged to remain informed about current issues pertaining to design and be proactive in their research.
- The College should seek to provide a multitude of study abroad opportunities able to accommodate students' different circumstances.
- Other opportunities such as the Practice Preview should be made available to expose students to the professional world.

- The College should also encourage student involvement in the community to influence design and its effect on the community at large.
- The University should be a laboratory for experimentation but should not be oblivious to design's role in the community.
- Faculty and students should invest significant time in drafting, communicating, and evaluating policy effectiveness such that feedback can further inform the development and implementation of studio culture policies as a tool.
- All students and instructors should be aware of the Studio Culture Policy and seek to uphold it. Conflict or violation of the policy should be addressed directly by the Dean and other concerned parties.
- To achieve this, all students and faculty should be given a digital copy of the Studio Culture Policy at the beginning of the academic year.

University of Kansas - School of Architecture, Design, and Planning Department of Architecture: The 'Studio Culture' Vision and Policy Statement *(06 May 2009)*

(Reconciliation Committee: S. Criss, B. Coffeen, M. Rashid, D. Sander, L. Foster, and K. Steinhoff)

In 2005, the National Architectural Accreditation Board (NAAB) requested that all schools develop a 'Studio Culture Policy' document that serves to provide a written policy identifying how each school of architecture addresses its studio culture. This effort encouraged academia to be more explicit about the pedagogical benefits of the studio experience. Prior to that, in 2003, the AIAS Studio Culture Task Force had created a document with the goal of encouraging schools to define explicit policies to support the positive aspects of the studio culture while transforming the more unhealthy practices. Five positive values were identified in the report including optimism, respect, sharing, engagement and innovation of which the School of Architecture and Urban Planning at the University of Kansas fully shares and supports as the basis of this document.

"Schools of architecture should constantly strive to promote architecture as a profession, not just a discipline, art form or occupation. As a profession it is our responsibility to first and foremost serve all people and society through the exploration of architecture as a means to improve the health, safety and welfare of the individual, community and nation. Architectural educators, administrators, and students should work together to establish and evolve the following cultures within their programs. It is anticipated that each school will find unique solutions to achieve these cultures.

Optimism

Schools should foster a sense of optimism in their students. Students should understand the challenges the profession faces while serving society. Consequently, they need to be engaged in discussions and projects while in school that will teach students how to design creative, thoughtful, and professional solutions. Practice should be promoted as an opportunity to expand and evolve the profession, not as a difficult place to perform the art of designing. Graduates should leave school with a high level of energy and excitement with the knowledge and belief each is an important member of the current and future profession. The role of a professional program is to promote and foster success of its students, not to set a quota for failure.

Respect

Schools should foster and promote a sense of respect for everyone. Disparaging remarks about other disciplines, faculty, students, and practitioners should not and cannot be tolerated. Every effort should be made to include all people from all backgrounds and lifestyles in the design studio to increase awareness of diversity and respect for everyone. This must go beyond the members of a particular design studio and include community members.

Sharing

The process of sharing knowledge, ideas, and experiences is the essence of the academy. Forums should be promoted for such exchanges between students, faculty, practitioners, and community members. Such sharing should happen between these groups as well as amongst peers within each group. A team approach in learning is vital to perpetuate a team approach in practice.

Engagement

Schools should actively work to ensure that each student obtains experience working with and engaging a specific community through the process of designing. Students should understand fully the implications of design on real people. This includes understanding the potential for the design process to strengthen communities.

Innovation

It is the role of the academy to promote innovation in design and practice. Schools should actively pursue creative and innovative developments in both areas equally. Particular focus should be placed on expanding professional services and methods of strengthening architects' active client base. Architects of today do not work alone or without constraints.

Students need to be taught about collaborative design, budgets and codes, not as limitations on their creativity, but as opportunities for creative problem solving."

(Source: www.aias.org/studioculture/r_resources_sctf_NAABpaper.pdf)

The Studio

The studio model is historically rooted in the École des Beaux Arts in Paris, where the "design problem" relied heavily on knowledgeable teachers and "learning by doing." Students were required to develop drawings of their projects for critique from a jury that generally consisted of professors and guest architects that evaluated the students' projects. This tradition of the "jury" or "final reviews" continues to be the common means of evaluation in architecture schools today, as is the case at KU's School of Architecture.

Studio learning encourages collaboration, risk-taking, critical-thinking processing, innovative-thinking, discussion, and "hands-on" experimentation. The design studio establishes an environment where students are challenged to move between intuitive processing of information; thinking through drawing and making; experimentation with materials and form; and, developing a variety of skills and technologies. Asking questions and making proposals that explore untested ideas are developed through criticism and discussion among classmates, faculty, practicing architects, and others. The goal of the program is to produce conceptual thinkers versed in history, theory, and the science of the field. Intensive one-on-one instruction provides the student the ability to develop verbal, critical-thinking, spatial, aesthetic and material sensibilities. The design studio draws upon life experiences, general studies courses and specific, architectural courses to provide a synthetic form of education. Students are exposed to a variety of cultural and societal ideas through history and theory, the environmental sciences and building technologies. The studio experience aims to provide an environment whereby diverse life experiences and opinions are shared—a culture of mutual respect and open inquiry is critical to a successful learning environment.

The architectural design studio is based on a group of people working together in a large open studio space where students are assigned desks to develop their design projects based upon common teaching methods: problem-based learning and learning-by-doing. This regular interaction between students and faculty provides an opportunity for students to share ideas, learn from one another, and contribute to each other productively. Extended spaces beyond the studio space include several university libraries including the Spencer Library and our own ‘Hatch Reading Room’; computer and media labs; wood and metal shops; and, review and exhibition spaces.

The desk critique or “desk crit” and “group crits” provide an opportunity for the student to meet with the faculty member for a one-on-one discussion of the design work. These sessions act as a form of critical feedback on the student’s progress and provide the means for discussion on how the student is addressing the stated objectives. The studio instructor often provides direction or suggests revisions that he or she feels will help the student reach a better design solution. As follow-up, it is expected that the student will more fully explore the work and advance the design work to a new level for the next class period. These steps are repeated regularly and these methods of revising the work, based upon critical-feedback are essential to the design process.

Faculty incorporate this method of teaching in individual ways, as is dictated by their own perspective on how to best teach design; ultimately, design decisions are made by the student.

Design studio reviews are essential moments in the semester, whereby interaction between students, faculty, and outside visitors are made possible in a formal “pin-up” manner. Reviews serve to provide a means of discussing and assessing the student work and provide feedback and serve as an opportunity to discuss broader issues of the project assignment. These reviews should be seen as an opportunity to exchange ideas and to practice effective verbal and visual presentation skills. The program supports thoughtful and respectful exchanges, open-minded debate, and discussion during these presentations.

Plan for Implementation and Maintenance

The 'Studio Culture Vision and Policy Statement' serves as a device for extending conversations between students and faculty. The Studio Culture committee is comprised of two students selected by the AIAS student organization and three faculty members. In May of 2009, the document was formally adopted as our working guide. The Studio Culture will inevitably evolve with changes in technology, the profession, and society. The policy must reflect the changes while nurturing a culture vital to the student experience. The Studio Culture Committee will work to maintain and further develop this stated policy through review sessions each year; these will then inform bi-annual recommendations for changes which will be forwarded to the faculty for review and implementation.

Studio Culture Policy

As the basis of this Policy, the following NAAB Conditions for Accreditation, 2004 Edition were consulted (http://www.naab.org/accreditation/2014_Conditions.aspx). In this document there are "Thirteen Conditions of Accreditation" of which one is focused on the "Studio Culture." in order to prepare documentation for the Accreditation Program Report (APR), the following describes this most clearly:

3.5 Studio Culture

The school is expected to demonstrate a positive and respectful learning environment through the encouragement of the fundamental values of optimism, respect, sharing, engagement, and innovation between and among the members of its faculty, student body, administration, and staff. The school should encourage students and faculty to appreciate these values as guiding principles of professional conduct throughout their careers.

The APR must demonstrate that the school has adopted a written studio culture policy with a plan for its implementation and maintenance and provide evidence of abiding by that policy. The plan should specifically address issues of time management on the part of both the faculty and students. The document on studio culture policy should be incorporated in the APR as Section 4.2.

The following represents the policy we have developed that is particular to our School's program. The adoption of this studio culture policy shall not infringe on the academic freedom of faculty to teach their courses, accountable and consistent with the published curriculum, in a manner that serves the best interests of the students, the profession, the School of Architecture and the University of Kansas. With a focus upon "specifically address(ing) issues of time management," we begin with the first three points of the "The Redesign of Studio Culture: A Report of the AIAS Studio Culture Task Force" (http://www.aias.org/website/download.asp?id=314): Students Should Lead Balanced Lives: "Architectural education should be challenging, rigorous, and time-consuming. However, as one noted practitioner stated, "If we want professionals to lead balanced, healthy lives, we should not expect them to put off practicing that mindset until later in life." Do our current practices promote successful habits? Is too much focus placed on the time spent in the design studio? Despite the difficulty of these questions, the answers must be sought and considered."

Related Policies:

All faculty (including part-time adjuncts) shall meet prior to the start of each semester. They will meet as two groups, same-year-level studio and core-architecture-elective instructors, to discuss content of the courses and deadlines of major projects and exams. (If possible, they will coordinate deadlines to alleviate overlaps— especially at mid-term and final week prior to Stop Day.) Studio projects are to be completed prior to Stop Day so that students may study for exams during Exam Week. Because design review space is limited, final studio reviews can occur during the Exam Week, but these must be coordinated with the students' exams so that time conflicts are avoided.

According to University policy, syllabi and details of the course are to be discussed with students on the first day whereby all faculty (studio and architecture courses) will announce their exam and project due dates to the students. Any obvious deadline conflicts should be discussed then, so that students are made aware and can plan accordingly. Architecture course instructors who are willing to work with studio project deadlines--by confirming alternative dates with their own students--may give "Tentative" Exam dates in the Syllabus, handed out to their students on the first day of class.

Typically, faculty are contracted to teach 40% of their time, perform service for 20% and engage in scholarship/research/practice for the remaining 40%. Scholarship and teaching are to be equally valued and are equally important to the quality of the school. Design studio classes are required to meet 11 hours/week (except for the first design studio which meets 8 hours/week). If faculty, or a student, must be away for conferences, practice obligations, or other such activity, a suitable substitute of time must be arranged to assure proper instruction. If students must leave the studio to work in the computer lab or woodshop, students should make the faculty aware so that they are not regarded as absent.

(Note: Policies outlined below in relation to the other two remaining points should also help students develop a healthy lifestyle).

Time is More Than a Constantly Endangered Resource: "Many responses to our task force have also proposed that a major solution to several of these issues would be to teach time management skills. Most schools place little emphasis on teaching these skills, and even fewer have classes directly dedicated to this topic. Students who manage their time well typically perform much better than those who do not. Good time management usually leads to stronger design projects due to a more balanced work schedule and allowing time for reflection. Also, good time managers have more successful reviews because they have allotted time to sleep as well as prepare for their oral (written, graphic, etc.) presentations."

Related Policies:

Students in architectural education know that it is a time-intensive activity and experience demonstrates students' coursework demands 60+ hours per week of their time. Making priorities is an essential skill to develop. Faculty will make general requirements and deadlines clear at the start of the semester and state specific deadlines during the course; ultimately, assisting students in setting appropriate priorities and time schedules for themselves.

Many students must work alongside attending school. Based on previous experience, it is recommended that students set a maximum of 10 hours/week for outside employment.

Within the first semester of the M. Arch program, a 'time management' workshop should be given to the Freshman class, so that students understand that the architecture curriculum is especially time-demanding and that they may apply given strategies in order to lead balanced lives. This will be incorporated in the 'Professional Practice' course offered in the first semester of the program.

In an effort to save valuable time, certain woodshop and computer technology skills should be taught as part of the design studio experience. This will help assure that all students have been given basic introductory skills that ultimately are incorporated into the design studio and other courses. It is recommended that workshops be taught through the Woodshop (with shop manager) and the Bridge Lab (with computer lab manager) to assure that the material is consistently being delivered to all students.

There is a World Outside of the Design Studio: "When students spend all of their waking time, and some of their sleeping time, … for four to six years, in the same classes, in the same building, they become disconnected from the ubiquitous public they will serve. Too often, faculty members do not encourage or even allow any unstructured time for students to develop interests and relationships outside of studio. This in large part can lead to clients accusing the profession of arrogance and ignorance. ‘If we want professionals to be involved in their communities, we should make sure that we are instilling in students a sense of involvement with others outside the architectural community.”

Related Policies:

The School of Architecture is committed to bringing outside lecturers to provide examples of innovative scholarship and practice. Typically, these lectures are scheduled from 11:30-12:30 (during studio periods). Participation is highly recommended. See the School’s website for current, scheduled lectures (http://architecture.ku.edu/calendar/architecture-ubpl).

The School is committed to bringing outside critics to provide comment on studio projects and deliver lectures within courses. Often, it is advantageous to hold reviews at firm locations (such as Kansas City) so that many practitioners are readily available to provide feedback.

Extra curricular activities are encouraged as a valuable aspect of a student’s development, while being respectful of curricular demands. Students are encouraged to engage service, memberships and activities outside the School as a way of balancing (and broadening) student life. (Students should not assume that they would automatically be allowed to engage in non-studio activities during studio hours; this must be negotiated with the critic ahead of time.) The School of Architecture and Urban Planning and the University of Kansas offers several student organizations to help students develop connections to outside practitioners and community activities. (http://www.sadp.ku.edu/school/people/students/orgs) and (http://www.silc.ku.edu).

We seek to have our students become leaders in a globalized profession. We therefore require study abroad or practicum experiences that foster student engagement in a unique situation. Students may study abroad for one week during a semester; one month during the summer or winter break; or go abroad for half or all of an academic year (http://studyabroad.ku.edu/ProgramTypes). The Global Awareness Program (GAP) is a KU initiative that recognizes undergraduates' international experiences. Students can receive transcript certification for experiences including study abroad, classes with an international focus, foreign language study, and international co-curricular activities (http://www.international.ku.edu/gap).

We seek opportunities for Service-Learning opportunities through studio design projects. This is well-established in the Studio 804 program and other opportunities have been developed in other studio courses. See http://kubuildingtech.org/creativework/ for current work. In addition to posting on the website, the School aims to provide frequent student-work exhibitions and hold brown bag lunches for discussion of the work. The Center for Service Learning provides support and resources for faculty in designing and implementing service learning courses. Through KU’s Center, students have the opportunity to become certified in service learning as a way to enhance their academic career. Upon completion of all requirements, the designation, “Certification in Service Learning,” will appear on the student’s official KU transcript (http://ccsr.ku.edu/about-service- learning for more details).

In order to assist students in their application to scholarships, unique topical studios employment opportunities, and Study Abroad opportunities (all that potentially require portfolios for application), students should be made aware of the need to document their work from the first semester. In order to support this, it is recommended that students develop documentation of their studio process and products in written and graphic ways. It is recommended that students do this for each of their design studios. Also, it is recommended that students save the images in a digital format for future portfolio-reconfiguration. With this, we believe that students will develop their abilities to reflect upon their work and will have material readily available.

The Research Experience Program (REP) is one of three undergraduate certificate programs at KU aimed at providing official recognition of an identified experience on a student's academic transcript. REP provides KU students with a unique learning opportunity grounded in KU's role as a major national research university (http://ugresearch.ku.edu/student/rep/overview).

For further definition, see the 2002 AIAS Task Force Report: (http://www.aias.org/website/download.asp?id=314).

- Design is the Integration of Many Parts
- Design Process is as Important as Product
- Collaboration is the Art of Design
- Design is Inherently an Interdisciplinary Act
- Even Educators Can Learn
- The Good of Students Must Prevail (yet to come: studio selection process)

- Grades Can Impede Productive Assessment
- Critiques are Learning Experiences, Not Target Practice
- To Design for Many, Parts of All Must be Included

The Design Studio Syllabus

Communication of core studio culture issues is best integrated into the design studio syllabi issued each semester. Beyond the typical elements included in syllabi (description of the course, basic information about the course, contact information, coursework required for successful completion, attendance policy and course schedule), other elements that affect our 'Studio Culture' and should be included in the syllabi are: NAAB Criteria Policy: "The National Architectural Accreditation Board accredits professional-degree seeking schools as they complete the basic requirements. *Note: each design studio has its own particular NAAB criteria to be addressed SPC matrix* (http://architecture.ku.edu/naab-1).

'Studio Culture': "According to the "NAAB Conditions for Accreditation, 2014 Edition" (see http://www.naab.org/accreditation/2014_Conditions.aspx), the school has created its 'Studio Culture Vision and Policy Statement' as stated on the School's website: (http://www.architecture.ku.edu/sites/architecture.ku.edu/files/docs/StudioCulture.pdf).

Building Use Policies: "Marvin Hall, Marvin Annex and Snow Hall are open 24 hours per day, every day of the year accessible to students and faculty of the Architecture Program. For the safety, health, courtesy and sense of community: proper use of the studio space is expected; students are responsible for all costs incurred for painting and/or repair; misuse of space will result in loss of studio privileges; it is the student's responsibility to see that all materials are removed from classrooms (including review rooms) at the end of each class period, and that no materials are left in public corridors, lobbies, stairs or other paths of egress; at the end of the semester, all personal and course materials must be removed from the buildings by the posted deadline or they will be discarded; it is the responsibility of each student to keep their area tidy from debris, carrying excess items to the trash can, dumpster or recycling bins; radio/sound systems are permitted only via headphones; no smoking in the building; cutting is to be done on lay-off tables and cutting boards only; the pin-up spaces immediately outside the studio are not for model-building or other tasks that can be performed inside the studio; the use of power tools is restricted to the indoor and outdoor shop spaces; and spraying of any kind is prohibited inside the building (use the outdoor building yard for any spraying)."

2010 Imperative: "To successfully impact global warming and world resource depletion, it is imperative that ecological literacy become a central tenet of design education. Yet today, the interdependent relationship between ecology and design is virtually absent in many professional curricula. To meet the immediate and future challenges facing our professions, a major transformation of the academic design community must begin today. All project statements in the design studio shall include the criterion that "the design engages the environment in a way that dramatically reduces or eliminates the need for fossil fuel" (http://www.architecture2030.org/2010_imperative/index.html).

‘Students with Disabilities’ Policy: “The KU Office of Disability Resources (DR), 22 Strong Hall, 785-864-2620, coordinates accommodations and services for all eligible students with disabilities. If you have a disability and wish to request accommodations and have not contacted DR, please do so as soon as possible. Information about their services can be found at http://www.disability.ku.edu. Please also contact your professor privately in regard to your needs in this course.”

Religious Holidays: “Any student in this course who plans to observe a religious holiday which conflicts with the course schedule or requirements should contact the instructor at the beginning of the semester to discuss alternate accommodations.”

‘Academic Misconduct’ Policy: “Academic misconduct by a student shall include, but not be limited to, disruption of classes; threatening an instructor or fellow student in an academic setting; giving or receiving of unauthorized aid on examinations or in the preparation of notebooks, themes, reports or other assignments; knowingly misrepresenting the source of any academic work; unauthorized changing of grades; unauthorized use of University approvals or forging of signatures; falsification of research results; plagiarizing of another's work; violation of regulations or ethical codes for the treatment of human and animal subjects; or otherwise acting dishonestly in research. When academic misconduct is alleged, the clear university policies and procedures expressed in the academic misconduct section, available at (http://policy.ku.edu/governance/USRR#art2sect6 will be followed). The University of Kansas is committed to programs and activities that are free of racial, sexual, or ethnic discrimination. For assistance or information on policies, please contact the University

Ombuds Office (http://www.ombuds.ku.edu/) or the Department of Human Resources & Equal Opportunity (http://www.hreo.ku.edu).

APPENDIX 02

UKY NAAB SPC TO CURRICULUM MAPPING

		Critical thinking & Representation								Building Practices, Technical Skills & Knowledge										Integrated Architectural Solutions			Professional Practice				
		A. 1 Professional Communication Skills	A. 2 Design Thinking Skills	A. 3 Investigative Skills	A. 4 Architectural Design Skills	A. 5 Ordering Systems	A. 6 Use of Precedents	A. 7 History & Global Culture	A. 8 Cultural Diversity & Social Equity	B. 1 Pre-Design	B. 2 Site Design	B. 3 Codes & Regulations	B. 4 Technical Documentation	B. 5 Structural Systems	B. 6 Environmental Systems	B. 7 Building Envelope Systems & Assemblies	B. 8 Building Materials & Assemblies	B. 9 Building Service Systems	B. 10 Financial Considerations	C. 1 Research	C. 2 Integrated Evaluations & Decision-Making Design Process	C. 3 Integrative Design	D. 1 Stakeholder Roles in Architecture	D. 2 Project Management	D. 3 Business Practices	D. 4 Legal Responsibilities	D. 5 Professional Conduct
History/Theory																											
Intro to Arch History & Theory	Arc 111							XI	XI																		
H&T: 15 - 17th Centuries	Arc 212						XR																				
H&T: 18 - 19th Centuries	Arc 213					XR	XD																				
H&T III: Twentieth Century	Arc 314	XI		XI																							
H&T IV: World Architecture & Urbanism	Arc 315							XD	XD																		
H&T: Seminar	Arc 511	XD		XR																							
H&T: Graduate Theory	Arc 511			XD																XD							
Design																											
Introduction to Design Studio	Arc 101																										
Studio I	Arc 151				XI																						
Studio II	Arc 252				XR	XI																					
Studio III	Arc 253						XI				XI																
Studio IV	Arc 354				XD					XR																	
Studio V	Arc 355										XR				XI												
Studio VI	Arc 456		XI							XD																	
Studio VIII	Arc 658		XD																								
Studio IX	Arc 659																			XR			XR				
Studio X: Comprehensive Studio	Arc 750											XD									XD	XD		XD	XR	XR	XR
Masters Project	Arc 759		XD																	XD			XD				
Technology																											
Structural & Material Concepts	Arc 231												XI	XI		XI											
Environmental Controls I	Arc 332														XR												
Environmental Controls II	Arc 333														XD	XR		XR									
Structures Design I	Arc 434					XD								XR													
Materials & Methods	Arc 435											XI	XR			XD	XR										
Structures Design II	Arc 533													XD			XR										
Building Systems Integration	Arc 631											XR	XD				XD	XD	XD		XR	XR		XR			
Prof. Practice & Techniques																											
Digital Media	Arc 203	XR																									
Introduction to Prof. Practice	Arc 641																		XR						XD	XD	XD

Curriculum mapping of NAAB SPC to history/theory, design studio, technology, and professional practice courses at the University of Kentucky.

UK SCHOOL OF ARCHITECTURE CURRICULUM FRAMEWORK FOR BACHELOR OF ARTS IN

	First Year				Second Year				
HISTORY/THEORY	Intro to Arch History & Theory	3			**H&T IV: World Architecture & Urbanism**	**3**	H&T I: 15-17th Centuries	3	NAAB REQUIRES 45 CREDITS OUTSIDE OF MAJOR (SHOWN IN LIGHT GREY)
	111				315		212		
DESIGN	**Studio I**	**6**	Studio II	6	Studio III	6	Studio IV	6	
	Weekly Studio Lecture		Weekly Studio Lecture		Weekly Studio Lecture		Weekly Studio Lecture		
	151		252		253		354		
BUILDING SCIENCE			Intro to Physics (1)	3	Structural & Material Concepts	3	**Materials & Methods**	**3**	COURSES IN DARK BLUE INVOLVE CHANGE OR REQUIRE ACTION (HIRING, ETC)
			PHY 151		231		435		
PRACTICE & TECHNIQUE	Visual Media I	3	**Visual Media II**	**3**					*** FUNDED LECTURE-WORKSHOPS GIVEN BY VISITING PRACTITIONERS & LEADING INNOVATORS IN THE FIELD
	101		203						
GENERAL STUDIES	Natural / Physics / Math (2)	3	Math / Logic / Statistical Reasoning (3)	3	Comm I (4)	3	Comm I (5)	3	
	MA 123				CIS/WRD 110		CIS/WRD 111		
		15		15		15		15	

	First Year		Second Year	
Studio Themes	Architectural Design Fundamentals; Introduction to Form, Space, Material, Light, Structure, Circulation & Program; Introduction to Problem Solving & Design Thinking; Methods of 2D & 3D Visual Communication;		Relationships in the Architectural Discipline: Architectural Precedents; Form & Space; Structure & Materiality; Public & Private Program; Circulation; Relationship between Building & Diverse Site Conditions	
Typical Project	Sequence of Design Problems that cumulatively involve Form/Space, Formal Ordering Systems, Circulation/Program; Application of diverse hand/digital visual communication methods	Sequence of Applied Architectural Problems that involve Inside/Outside Public/Private Movement/Stasis; with application of increasingly complex visual communication methods	Architectural object in aggregation, with challenges of site and context, attention focused upon formal strategies for obtaining thematic unity. Use of precedents to inform design	Develop architecture within a complex urban condition, which requires programmatic definition and design to provide diverse kinds of public and private spaces within a civic context.
Scale & Program	Relative Scales, Program as Problem	1-2,000sft Simple Programs	15-20,000sft Aggregated Housing	5-15,000sft Cultural/Civic or Institutional Program
Site Conditions/Constraints	Light, Gravity, Approach	Landscapes, Program, View, North	Complex Landscape, Simplified Climate	Civic Space in an Urban Context
Co-Requisite	Visual Media I	Visual Media II	Structural & Material Concepts	Environmental Controls I
Goals, Objectives & Outcomes	Demonstrate basic formal, organizational principals of design through small architectural interventions, demonstrate range of 2D/3D visual communication	Demonstrate an understanding of the Impact of Form on space through applying it to serve program, circulation, environment material & structure	Use Program as Driver; Housing; Aggregation; Precedent Use; Landscape; Applied Digital Technique	Pursue an Urban Analysis and translate into architecture with a Complex Program that serves the public
NAAB Criteria Covered within Studio	Architectural Design Skills	Architectural Design Skills Ordering Systems	Site Design Use of Precedents	Pre-Design Architectural Design Skills
Events, Gates & Milestones				

Curriculum framework for a Bachelors of Arts in Architecture at the University of Kentucky – Undergraduate Academic levels 1 and 2.

UKY SCHOOL OF ARCHITECTURE CURRICULUM FRAMEWORK FOR BACHELOR OF ARTS IN ARCHITECTURE

	Third Year		Fourth Year		
HISTORY/THEORY	H&T II: 18th-19th Centuries 3 213	H&T III: Twentieth Century 3 314	H&T: Seminar 3 515	Elective (10) 3 599	NAAB REQUIRES 45 CREDITS OUTSIDE OF MAJOR (SHOWN IN LIGHT GREY)
DESIGN	Studio V Fall Visiting Workshop Series I & II *** 6 355	Studio VI Spring Visiting Workshop Series I & II *** 6 456	**BA Architecture requires no Studio in 4th Year. Compressed 5-Year Track Begins Graduate Studio Sequence in 4th Year.**		
BUILDING SCIENCE	**Environmental Controls I 3** 332	**Environmental Controls II 3** 333	Structures Design I 3 434	Elective (11) 3 599	COURSES IN DARK BLUE INVOLVE CHANGE OR REQUIRE ACTION (HIRING, ETC)
PRACTICE & TECHNIQUE			Elective (12) 3 599	Elective (13) 3 599	*** FUNDED LECTURE-WORKSHOPS GIVEN BY VISITING PRACTITIONERS & LEADING INNOVATORS IN THE FIELD
GENERAL STUDIES	Social Sciences (6) 3	Arts & Creativity (7) 3	UK Core (8) 3	UK Core (14) 3	
			UK Core (9) 3	UK Core (15) 3	
	15	15	15	15	
					60

	Third Year		Fourth Year
Studio Themes	Relationships between Architecture and External Conditions: Design for Site & Environment; Applied Research; Design with Community & Stakeholders		BA Architecture requires no Studio in 4th Year. Compressed 5-Year Track Begins Graduate Studio Sequence in 4th Year.
Typical Project	Design to immerse a visiting public into a complex landscape condition, and deploy an integrated, passive environmental design strategy and developed building enclosure.	Outreach project that involves intensive research and engagement with stakeholders outside of the architectural discipline	
Scale & Program	10-20,000sft Cultural/Civic or Institutional Progarm	Buildings of diverse programs & scales	
Site Conditions/Constraints	Complex Landscape & Complex Climate	Research & Stakeholders	
Co-Requisite	Environmental Controls II		
Goals, Objectives & Outcomes	Immerse public into a complex landscape condition, and deploy an integrated environmental design strategy	Pursue research and analysis and translate it into an architectural outcome; Engage stakeholders in project development and communications	
NAAB Criteria Covered within Studio	Site Design	Pre-Design Design Thinking Skills	
Events, Gates & Milestones		Students can substitute ARC 456 with Study Abroad after Third Year	4th Year Fall Portfolio Review / Grad School Application Prep

Curriculum framework for a Bachelors of Arts in Architecture at the University of Kentucky – Undergraduate Academic levels 3 and 4.

UKY SCHOOL OF ARCHITECTURE CURRICULUM FRAMEWORK FOR BACHELOR OF ARTS IN ARCHITECTURE (4 YEARS) + MASTER OF ARCHITECTURE (2 YEARS)

	Grad I		Grad II		
HISTORY/THEORY	H&T: Graduate Theory 3 511				NAAB REQUIRES 45 CREDITS OUTSIDE OF MAJOR (SHOWN IN LIGHT GREY)
DESIGN	**Studio VIII** Fall Visiting Workshop Series I & II *** 6 658	Studio IX Spring Visiting Workshop Series I & II *** 6 659	Studio X: Integrated Design Studio Fall Visiting Workshop Series I & II *** 6 750	Masters Project Spring Visiting Workshop Series I & II *** 9 759	
BUILDING SCIENCE		Structures Design II 3 641	Building Systems Integration 3 631	**Elective: Structures III** 3	COURSES IN DARK BLUE INVOLVE CHANGE OR REQUIRE ACTION (HIRING, ETC)
PRACTICE & TECHNIQUE	**Professional Practice & Digital Tools** 3 642	**Elective: Visual Media III** 3	Intro to Prof Practice 3 641		*** FUNDED LECTURE-WORKSHOPS GIVEN BY VISITING PRACTITIONERS & LEADING INNOVATORS IN THE FIELD
GENERAL STUDIES					
	12	12	12	12	
				48	

Studio Themes	Apply a Critical Position to Technology Concepts; Application of Advanced Digital Techniques; Open Design Outcomes	Applied Research; Design with Community & Stakeholders; Open Design Outcomes	Integrative Design Studio	Applied Research; Design with Community & Stakeholders
Typical Project	Research Intensive Project that applies analysis and critical thought to integrated, holistic design outcomes	Research Intensive Project that applies analysis and critical thought to integrated, holistic design outcomes		Research Intensive Project that applies analysis and critical thought to integrated, holistic design outcomes
Scale & Program				
Site Conditions/Constraints	Complex Site	Research & Stakeholders		Research & Stakeholders
Co-Requisite			Building Systems Integration	
Goals, Objectives & Outcomes	Ability to define a program and translate it into an architectural proposal on a complex site	Demonstrate an ability to translate a research program into an architectural proposal and to negotiate complexities with stakeholders		Demonstrate an ability to translate a research program into an architectural proposal and to negotiate complexities with stakeholders
NAAB Criteria Covered within Studio	Pre Design Site Design	Research (Integrated) Stakeholders in Arch	Integrated Decision Making Integrative Design	Research (Integrated) Stakeholders in Arch
Events, Gates & Milestones				

Curriculum framework for a Bachelors of Arts in Architecture at the University of Kentucky – Graduate Academic levels 5 and 6.

APPENDIX 03

STRUCTURED FACULTY FOCUS GROUP PROTOCOL

Faculty Focus Group - Protocol for Focus Group Interviews

1. What types of design studios exist at the Texas A&M University College of Architecture-Department of Architecture?
2. What types of projects does your studio typically undertake?
3. How many assignments/projects do your students complete in a typical semester?
4. Do you provide your students with a rubric for understanding how their evaluation will be conducted?
5. How are your studio course objectives linked to accreditation performance indicators?
6. Do your student interact with real clients? If so, how?
7. What are important things for the students to convey to members of the jury or the general public?
8. What would you like the juror to get out of the exchange?
9. What evidence would show you that the knowledge exchange between the students and the client was successful?
10. How do you think I could find this evidence?
11. What would you like the jury members and general public to do as a result of the exchange?
12. What perceptions of the jury exchange are important to capture?

APPENDIX 04

STRUCTURED FACULTY INTERVIEW PROTOCOL

Individual Faculty - Interview Protocol

1. Based upon the consensus reached in the faculty focus group, which studio type best aligns with your current studio?
2. Can you elaborate?
3. Does your studio work within the discipline? Outside of the discipline? Across disciplines? If so, which ones?
4. Can you describe the context of your design studio teaching environment?
5. Based upon the consensus reached in the faculty focus group, which project type best aligns with your current studio?
6. Can you elaborate?
7. How does this context align with your teaching pedagogy?
8. How does your teaching pedagogy align with the profession?
9. How many assignments/projects will your students complete in a typical semester?
10. Does each project have an evaluation rubric?
11. If so, do you provide your students with a rubric for understanding how their evaluation will be conducted?

APPENDIX 05

SYLLABUS CONTENT RUBRIC

Syllabus Rubric - Required Components	Scoring	
	Present	Absent
General Course Information		
Full and accurate title of the course.		
Departmental and college prefix.		
Course prefix, number and section number.		
Scheduled meeting day(s), time and place.		
Instructor Contact Information		
Instructor name.		
Contact information for teaching/graduate assistant, etc.		
Preferred method for reaching instructor.		
Office phone number.		
Office address.		
Faculty email address.		
Times of regularly scheduled office hours and if prior appointment is required.		
Course Description		
Detailed overview of the course.		
Student learning outcomes (SLO).		
Course goals/objectives.		
Required materials (textbook, lab materials, etc.).		
Outline of the content, which must conform to the Bulletin description.		
Summary description of the components that contribute to the determination of course grade.		
Tentative course schedule that clarifies topics, specifies assignment due dates, examination date(s).		
Final examination information: date, time, duration and location.		
For 100-, 200-, 300-, 400-, 400G- and 500-level courses, numerical grading scale and relationship to letter grades for *undergraduate* students.		
For 400G-, 500-, 600- and 700-level courses, numerical grading scale and relationship to letter grades for *graduate* students. (Graduate students cannot receive a “D” grade.)		
Relative value given to each activity in the calculation of course grades (Midterm=30%; Term Project=20%, etc.).		
Note that undergraduate students will be provided with a Midterm Evaluation (by the midterm date) of course performance based on criteria in syllabus.		
Policy on academic accommodations due to disability		

Course Policies		
Attendance.		
Excused absences.		
Make-up opportunities.		
Verification of absences.		
Submission of assignments.		
Academic integrity, cheating & plagiarism.		
Classroom behavior, decorum and civility.		
Professional preparations.		
Group work & student collaboration.		

Syllabus Rubric - Best Practice Components	**Scoring**	
	Present	**Absent**
List of required texts, recommended texts and readings		
Course description from catalogue		
Course student learning outcomes (SLOs) identified		
Course SLOs written in active language and describe student behaviours or student work that could be directly measured.		
Topics covered in the course		
Exams and grading. Describe how the instructor will evaluate student work in the course.		
Describe required exams and assignments and how these will be evaluated and weighted to compute the final grade in the course.		
Statement about proctored exams (required only for courses with online exams)		
Attendance policy (eLearning: participation element is a part of the grade, policies about logging onto the class site regularly).		
Statement of University academic conduct policy/plagiarism policy		
Notification of use of turnitin (required only if instructor has written assignments and plans to use turnitin to evaluate originality of student writing)		
Statement about assistance for students with special needs (ADA statement). Must include contact information for the campus ADA office (link to website, telephone number)		
Emergency planning information for course continuity (e.g. weather, campus epidemic)		
Calendar of important events (schedule of required readings, assignment due dates, exam dates, etc.). Dates can be identified as tentative dates and/or subject to change.		

Syllabi content scoring rubric (Stanny, Gonzalez, & McGowan, 2015).

APPENDIX 06

FACULTY RECRUITMENT E-MAIL

Email to Faculty:
Dear NAME OF RECIPIENT:

You are receiving this email because you teach a design studio course at the Texas A&M University College of Architecture-Department of Architecture. The Principal Investigator and Protocol Director of this project would like to request your help in developing measures to evaluate student self-efficacy related to the design and communication of studio projects in design studio courses at the Texas A&M University College of Architecture-Department of Architecture. Your participation will involve joining a focus group discussion to discuss the kinds of studios, projects, and interactions that students may have with clients and the knowledge that needs to be transferred between students and community members (if applicable).

This discussion is for study purposes only and is completely voluntary.

If you are willing to help with this study, please click on the link below to complete a Doodle poll with the times that you are available. On the day of the focus group, you will receive a consent form with more information about how information will be collected and used, but if you have any questions about the study, please contact me below.

Sincerely,

gregory a. LUHAN, PhD Candidate
Texas A&M University
E-mail: gregory.luhan@email.tamu.edu
Phone: 859-492-5942

APPENDIX 07

FACULTY CONSENT FORMS

FACULTY - CONSENT FORM

Project Title: **Measuring Self-Efficacy in the Design Studio Context**

You are invited to take part in a research study being conducted by Gregory A. Luhan, the Protocol Director, a researcher from Texas A&M University and Dr. Mark J. Clayton, the Study Principal Investigator. The information in this form is provided to help you decide whether or not to take part. If you decide to take part in the study, you will be asked to sign this consent form. If you decide you do not want to participate, there will be no penalty to you, and you will not lose any benefits you normally would have.

Why Is This Study Being Done?
The purpose of this study is to study student self-efficacy in design studios. By doing this study, the researchers hope to better understand the types of design studios, the types of projects, a rubric for assessing a project score, the level of collaboration amongst students in design studio courses, the ability of a student to communicate their designs to stakeholders both inside and outside of the campus community, and its combined influence on student self-efficacy.

Why Am I Being Asked To Be In This Study?
You are being asked to be in this study because you are a faculty member teaching in a design studio course in the Texas A&M University College of Architecture-Department of Architecture.

How Many People Will Be Asked To Be In This Study?
30 people (participants) will be invited to participate in this study locally.

What Are the Alternatives to being in this study?
No, the alternative to being in the study is not to participate.

What Will I Be Asked To Do In This Study?
You will be asked to participate in a focus group discussion prior to the beginning of the semester to talk about design studio pedagogy, categorization of studio types, project types, and the ability to use a rubric to evaluate a project score. In addition, the focus group will discuss how students interact with each other, work in design studio, interact with community members (if applicable), and how students communicate their designs. You will then be asked to participate in a one-on-one interview to discuss your current assignment, to categorize your studio type and project type categories, and to provide the researchers with a copy of your studio syllabi (if you have not already done so). At the end of the semester, you will be asked to participate in a post-semester interview. Your participation in this study will last up to two hours over the course of the semester. This time commitment includes a 90-minute focus group and two 15-minute interviews – one at the beginning of the semester and one at the end of the semester.

Will Photos, Video, or Audio Recordings Be Made Of Me during the Study?
The researchers will make an audio recording of the focus group discussion and the individual interviews during the study so that so that they can be reviewed from both communication and architectural perspectives, but only if you give your permission to do so. Indicate your decision below by initialing in the space provided.

IRB NUMBER: IRB2015-0860D
IRB APPROVAL DATE: 01/22/2016
IRB EXPIRATION DATE: 01/15/2017

________ I give my permission for audio recordings to be made of me during my participation in this research study.

________ I do not give my permission for audio recordings to be made of me during my participation in this research study.

Are There Any Risks To Me?
The things that you will be doing are no more than risks than you would come across in everyday life.

Although the researchers have tried to avoid risks, you may feel that some questions that are asked of you will be stressful or upsetting. You do not have to answer anything you do not want to.

You will be assigned a number during the focus group. When recordings are transcribed, participant names will be replaced with a role designation (faculty) and number. We will audiotape the discussion and your number will only identify you on the recording and in the transcript. However, confidentiality in the focus groups cannot be guaranteed because other subjects present will know what was said and by whom.

Will There Be Any Costs To Me?
Aside from your time, there are no costs for taking part in the study.

Will I Be Paid To Be In This Study?
You will not be paid for being in this study.

Will Information From This Study Be Kept Private?
The records of this study will be kept private. No identifiers linking you to this study will be included in any sort of report that might be published. Research records will be stored securely and only the Protocol Director and the Principal Investigator will have access to the records.

Information about you will be stored on a secure, password-protected server located on the Texas A&M University campus in the College of Architecture; Building Langford A. Printed materials will be stored in a locked file cabinet. This consent form will be filed securely in an official area.

People who have access to your information include the Principal Investigator, the Protocol Director, and the honest broker. Any information that is sent to the Principal Investigator and the Protocol Director will be coded with a number so that they cannot tell who you are. The honest broker is the only person who can see information that is linked to you and has your name on it. Information about you will be kept confidential to the extent permitted or required by law. Representatives of regulatory agencies such as the Office of Human Research Protections (OHRP) and entities such as the Texas A&M University Human Subjects Protection Program may access your records to make sure the study is being run correctly and that information is collected properly.

IRB NUMBER: IRB2015-0860D
IRB APPROVAL DATE: 01/22/2016
IRB EXPIRATION DATE: 01/15/2017

Who may I Contact for More Information?
You may contact the Principal Investigator, Dr. Mark J. Clayton to tell him about a concern or complaint about this research at 979-845-2300 or mark-clayton@tamu.edu. You may also contact the Protocol Director, Gregory A. Luhan at 859-492-5942 or gregory.luhan@tamu.edu.

For questions about your rights as a research participant, to provide input regarding research, or if you have questions, complaints, or concerns about the research, you may call the Texas A&M University Human Research Protection Program office by phone at 1-979-458-4067, toll free at 1-855-795-8636, or by email at irb@tamu.edu.

What if I Change My Mind About Participating?
This research is voluntary and you have the choice whether or not to be in this research study. You may decide to not begin or to stop participating at any time. If you choose not to be in this study or stop being in the study, there will be no effect on your employment, evaluation, or relationship with Texas A&M University. Any new information discovered about the research will be provided to you. This information could affect your willingness to continue your participation.

STATEMENT OF CONSENT
I agree to be in this study and know that I am not giving up any legal rights by signing this form. The procedures, risks, and benefits have been explained to me, and my questions have been answered. I know that new information about this research study will be provided to me as it becomes available and that the researcher will tell me if I must be removed from the study. I can ask more questions if I want. A copy of this entire consent form will be given to me.

Participant's Signature   Date

Printed Name   Date

INVESTIGATOR'S AFFIDAVIT:
Either I have or my agent has carefully explained to the participant the nature of the above project. I hereby certify that to the best of my knowledge the person who signed this consent form was informed of the nature, demands, benefits, and risks involved in his/her participation.

Signature of Presenter   Date

Printed Name   Date

IRB NUMBER: IRB2015-0860D
IRB APPROVAL DATE: 01/22/2016
IRB EXPIRATION DATE: 01/15/2017

APPENDIX 08

FACULTY SELF-REPORT STUDIO AND PROJECT TYPE

The following questions ask about your experience with project types. Project type is defined as the content and method of project investigation (Lueth, 2008). Please rate the extent to which your project was hypothetical or real by moving the slider to an appropriate number.

	Hypothetical										Real
	0	10	20	30	40	50	60	70	80	90	100
My project site was...											
My project program was...											
My project client was...											

Please rate the extent of community involvement in your project by moving the slider to an appropriate number based on the following criteria:

Community Not-engaged: No Community Involvement
Community Partially-engaged: Community was involved in design reviews only.
Community Fully-engaged: The Community was involved in studio work to realize common objectives through brainstorming, reviews, community presentations, feedback, and learning outcomes demonstrate a clear community benefit.

	Not-engaged					Partially-engaged					Fully-engaged
	0	10	20	30	40	50	60	70	80	90	100
The community was...											

Please rate the extent of your project's realization by moving the slider to an appropriate number based on the following criteria:

Unbuilt: Drawn-only, not modeled or constructed
Partially-built: Drawn and modeled at some scale, but not at full-scale
Built: Drawn and modeled, and then constructed at full-scale

	Unbuilt					Partially-built					Built
	0	10	20	30	40	50	60	70	80	90	100
The project was...											

The following question asks about your experience with studio types. Studio type is defined as the context of student learning. Please rate the extent to which your studio work was done individually or in teams by moving the slider to an appropriate number.

	Individual Work Only										Team Work Only
	0	10	20	30	40	50	60	70	80	90	100
My studio work is...											

APPENDIX 09

DESIGN SELF-EFFICACY INSTRUMENT AND CONSENT

Default Question Block

Block Options

Cover

Measuring Self-efficacy in the Design Studio Context

The survey/questionnaire will take about 15 minutes to complete. Your participation is voluntary and you may leave at any time.

Click "NEXT" to proceed. Click "BACK" to go back. Please do not use the back button on your browser.

You do not need to complete the survey in one session. You may save your work and return later by simply exiting your browser and using the link in your invitation to return.

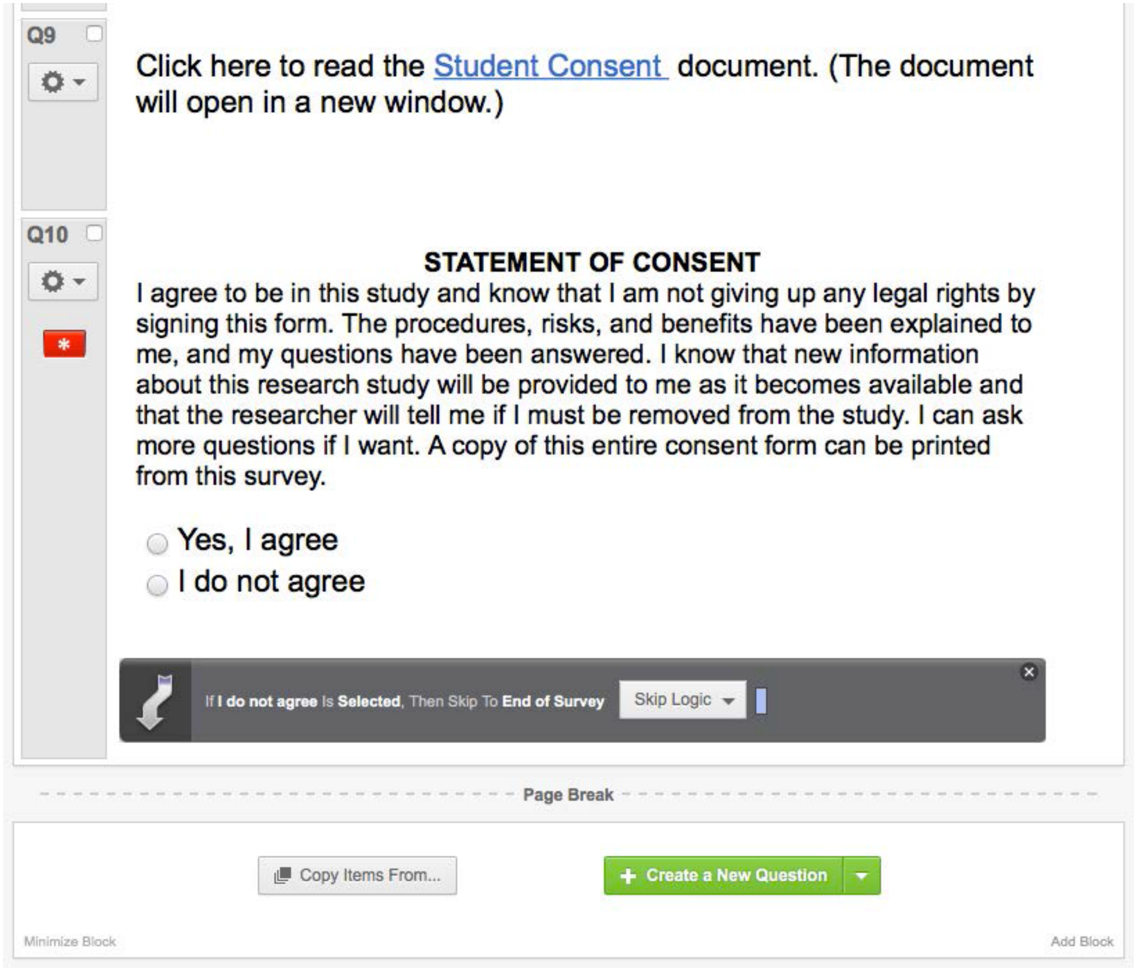
Please read the student consent document and click "agree" to take the survey.

You may contact the Principal Investigator, Dr. Mark J. Clayton to tell him about a concern or complaint about this research at 979-845-2300 or mark-clayton@tamu.edu. You may also contact the Protocol Director, Gregory A. Luhan at 859-492-5942 or gregory.luhan@tamu.edu.

For questions about your rights as a research participant, to provide input regarding research, or if you have questions, complaints, or concerns about the research, you may call the Texas A&M University Human Research Protection Program office by phone at 1-979-458-4067, toll free at 1-855-795-8636, or by email at irb@tamu.edu.

I thank you in advance for your assistance with this important project.

Sincerely,
Gregory A. Luhan, Protocol Director
PHONE: 859-257-6568
E-MAIL: gregory.luhan@tamu.edu



Q9

Click here to read the Student Consent document. (The document will open in a new window.)

Q10

STATEMENT OF CONSENT

I agree to be in this study and know that I am not giving up any legal rights by signing this form. The procedures, risks, and benefits have been explained to me, and my questions have been answered. I know that new information about this research study will be provided to me as it becomes available and that the researcher will tell me if I must be removed from the study. I can ask more questions if I want. A copy of this entire consent form can be printed from this survey.

- Yes, I agree
- I do not agree

If **I do not agree** Is **Selected**, Then Skip To **End of Survey** Skip Logic

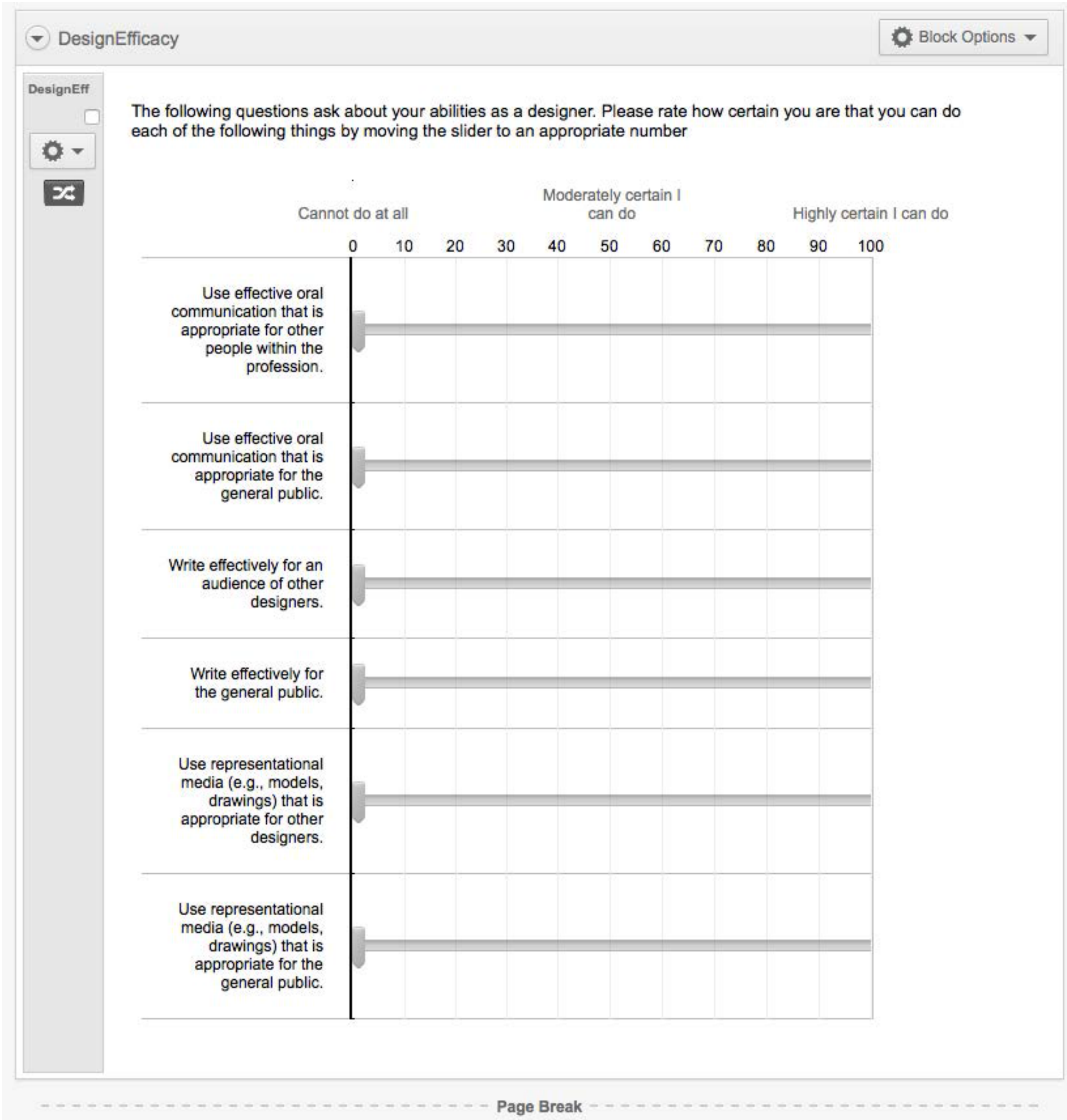
Page Break

Copy Items From...

Create a New Question

Minimize Block

Add Block


DesignEfficacy

Block Options

DesignEff

The following questions ask about your abilities as a designer. Please rate how certain you are that you can do each of the following things by moving the slider to an appropriate number

	Cannot do at all				Moderately certain I can do					Highly certain I can do
	0	10	20	30	40	50	60	70	80	90	100
Use effective oral communication that is appropriate for other people within the profession.											
Use effective oral communication that is appropriate for the general public.											
Write effectively for an audience of other designers.											
Write effectively for the general public.											
Use representational media (e.g., models, drawings) that is appropriate for other designers.											
Use representational media (e.g., models, drawings) that is appropriate for the general public.											

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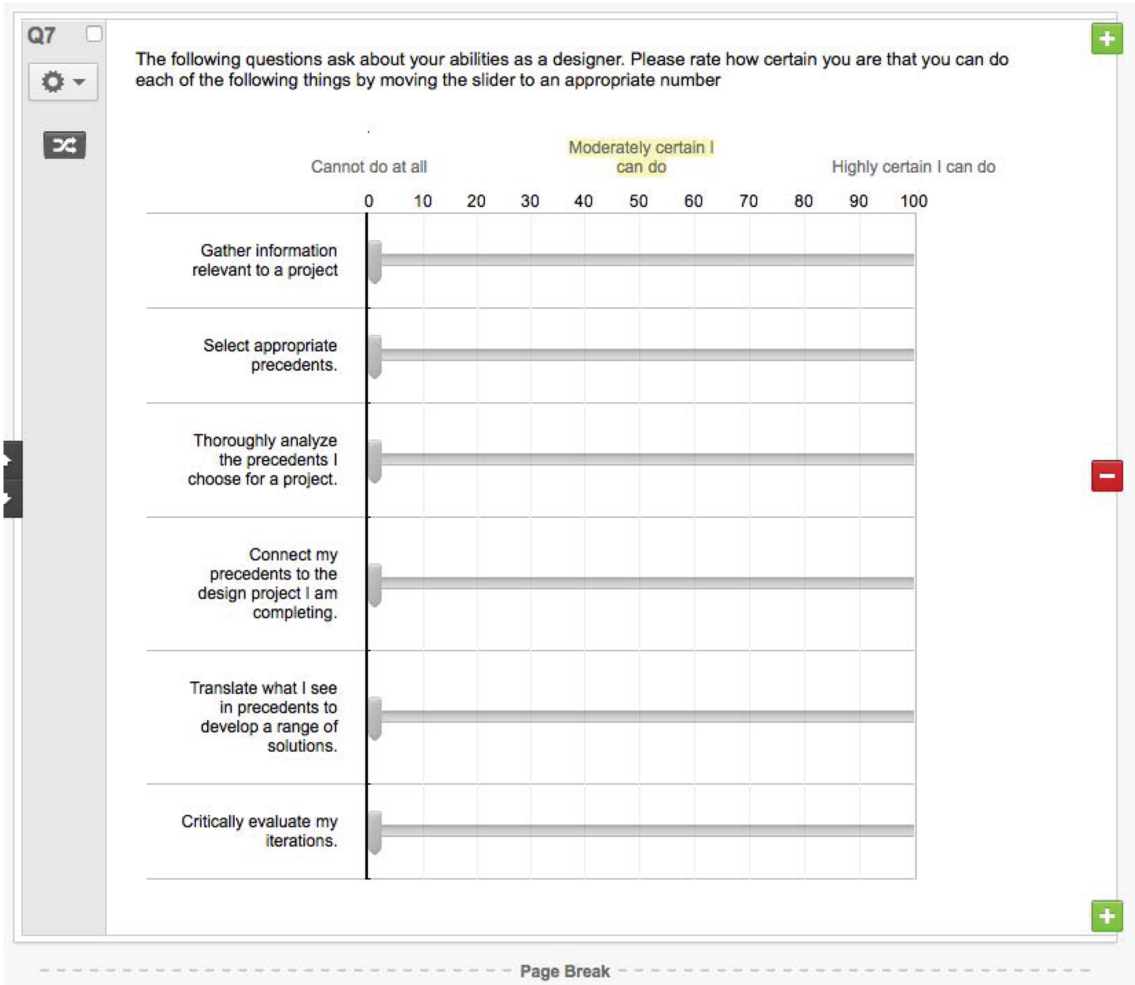
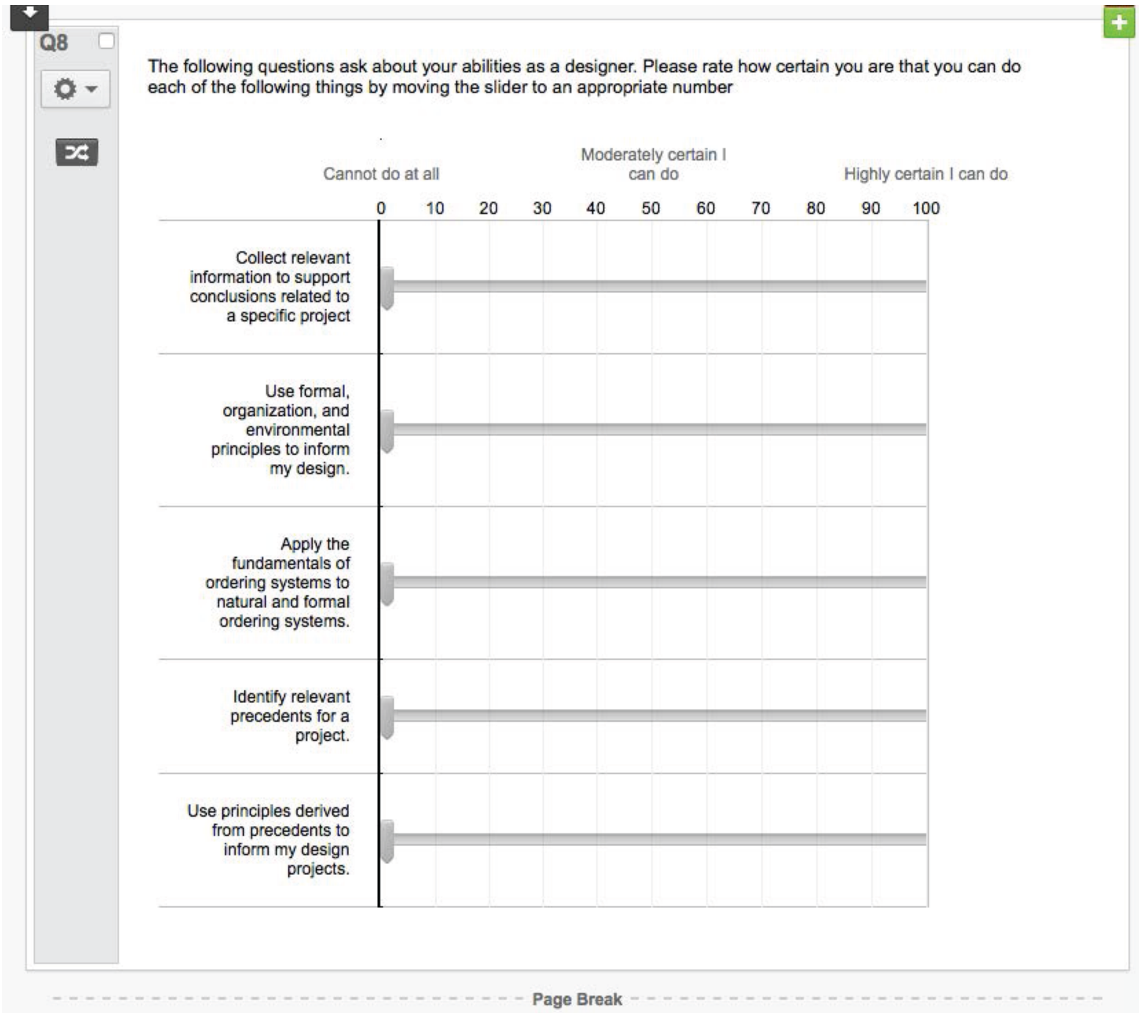


Q7

The following questions ask about your abilities as a designer. Please rate how certain you are that you can do each of the following things by moving the slider to an appropriate number

	Cannot do at all				Moderately certain I can do						Highly certain I can do
	0	10	20	30	40	50	60	70	80	90	100
Gather information relevant to a project											
Select appropriate precedents.											
Thoroughly analyze the precedents I choose for a project.											
Connect my precedents to the design project I am completing.											
Translate what I see in precedents to develop a range of solutions.											
Critically evaluate my iterations.											

Page Break


Q8

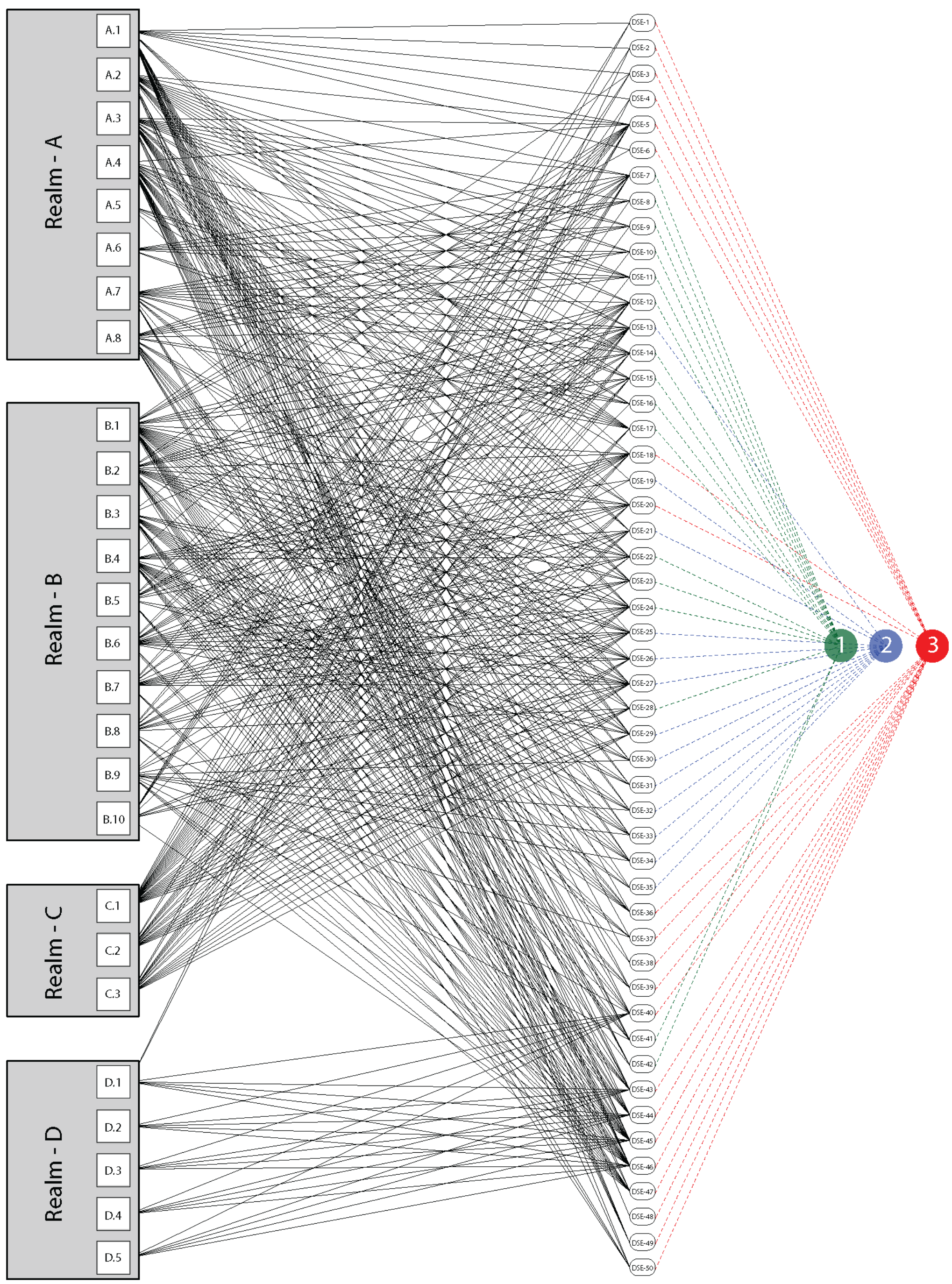
The following questions ask about your abilities as a designer. Please rate how certain you are that you can do each of the following things by moving the slider to an appropriate number

	Cannot do at all					Moderately certain I can do					Highly certain I can do
	0	10	20	30	40	50	60	70	80	90	100
Collect relevant information to support conclusions related to a specific project											
Use formal, organization, and environmental principles to inform my design.											
Apply the fundamentals of ordering systems to natural and formal ordering systems.											
Identify relevant precedents for a project.											
Use principles derived from precedents to inform my design projects.											

Page Break

APPENDIX 10

NAAB SPC MAPPING TO DSE



DSE SE Code	TASK Definition *[I can . . .]*	NAAB SPC
DSE_1	Use effective oral communication that is appropriate for other people within the profession.	A.1, B.10, C.1
DSE_2	Use effective oral communication that is appropriate for the general public.	A.1, B.10, D.1
DSE_3	Write effectively for an audience of other designers.	A.1, B.1, B.10, C.1
DSE_4	Write effectively for the general public.	A.1, B.10, D.1
DSE_5	Use representational media (e.g., models, drawings) that is appropriate for other designers.	A.1, A.2, A.3, A.4, B.1, B.2, B.3, B.4, B.5, B.6, B.7, B.8, C.1
DSE_6	Use representational media (e.g., models, drawings) that is appropriate for the general public.	A.1, B.1
DSE_7	Gather information relevant to a project	A.2, A.3, A.6, A.8, B.1, B.2, B.5, B.6, B.7, B.8, C.1, C.2, C.3
DSE_8	Select appropriate precedents.	A.3, A.6, A.7, A.8, C.1
DSE_9	Thoroughly analyze the precedents I choose for a project.	A.2, A.3, A.6, A.7, A.8, C.1
DSE_10	Connect my precedents to the design project I am completing.	A.2, A.3, A.6, A.7, A.8, C.1
DSE_11	Translate what I see in precedents to develop a range of solutions.	A.2, A.3, A.4, A.6, A.7, A.8, C.1
DSE_12	Critically evaluate my iterations.	A.2, A.3, A.7, B.1, B.2, B.3, B.5, B.6, B.7, B.8, C.1, C.2, C.3
DSE_13	Collect relevant information to support conclusions related to a specific project	A.2, A.3, A.7, A.8, B.1, B.2, B.5, B.6, B.7, B.8, B.9, B.10, C.1, C.2, C.3
DSE_14	Use formal, organization, and environmental principles to inform my design.	A.2, A.,4, A.5, A.7, B.1, B.2, B.5, B.6, C.1, C.2, C.3
DSE_15	Apply the fundamentals of ordering systems to natural and formal ordering systems.	A.2, A.4, A.5, B.1, B.2, B.5, B.6, C.1, C.2, C.3
DSE_16	Identify relevant precedents for a project.	A.2, A.3, A.6, A.7, A.8, C.1
DSE_17	Use principles derived from precedents to inform my design projects.	A.2. A.3, A.4, A.5, A.6, A.7, A.8, C.1, C.2, C.3
DSE_18	Create technically clear drawings	A.1, A.4, B.1, B.2, B.4, B.5, B.6, B.7, B.8, B.9, C.1, C.2, C.3
DSE_19	Prepare outline specifications	A.1, B.4, B.8
DSE_20	Construct models that illustrate and identify all necessary information for a building design	A.1, A.4, A.5, B.1, B.2, B.4, B.5, B.6, B.8, C.1, C.2, C.3
DSE_21	Demonstrate the mechanics and material behavior related to building structures through drawings, details, and structural analysis.	A.1, A.2, A.3, B.4, B.6, B.7, B.9, C.1, C.2, C.3
DSE_22	Utilize the principles of environmental systems to develop designs for an environmentally responsive building for a given geographic region.	A.2, A.3, A.4, A.7, B.1, B.2, B.4, B.6, B.7, C.1, C.2, C.3
DSE_23	Identify the design problem	A.2, A.3, A.4, A.7, B.1, B.2, B.6, B.7, B.8, C.1
DSE_24	Set evaluative criteria for possible designs	A.2, A.3, A.4, A.8, B.1, B.2, B.3, B.6, B.7, B.8, B.10, C.1, C.2, C.3
DSE_25	Analyze designs using set criteria	A.2, A.8, B.1, B.2, B.3, B.6, B.7, B.8, B.10, C.1, C.2, C.3

Table xx. Design Self-efficacy (DSE) Opertational Structure Connecting Self-effiacacy to National Architectural Accreditation Board (NAAB) Student Performance Criteria (SPC). DSE Items 1-25

DSE SE Code	TASK Definition *[I can . . .]*	NAAB SPC
DSE_26	Predict the effectiveness of a design if implemented.	A.2, A.8, B.1, B.2, B.3, B.6, B.7, C.1, C.2, C.3
DSE_27	Make design decisions in complex projects while considering the variety of influences (e.g., accessibility, environmental systems, structural systems).	A.3, A.4, A.5, A.7, B.1, B.2, B.4, B.5, B.6, B.7, B.9, B.10, C.1, C.2, C.3
DSE_28	Develop a user needs assessment and analysis to respond effectively and efficiently to stated project requirements.	A.3, A.4, A.7, B.1, B.8, B.10, C.1, C.2, C.3
DSE_29	Respond to specific site characteristics in my designs.	A.2, A.3, A.4, A.7, B.1, B.2, B.5, B.6, , C.1, C.2, C.3
DSE_30	Determine the applicable building code, occupancy group(s), and construction type	A.3, A.4, B.1, B.3, B.4, B.9
DSE_31	Determine allowable area and height	A.3, A.4, B.1, B.3, B.4
DSE_32	Calculate occupant load	A.3, A.4, B.1, B.3, B.4, B.9
DSE_33	Establish points of exit	A.3, A.4, A.8, B.1, B.3, B.4, B.9
DSE_34	Check egress paths for travel distance	A.3, A.4, A.8, B.1, B.3, B.4, B.9
DSE_35	Determine fixture counts.	A.3, A.8, B.3, B.4
DSE_36	Talk about specific parts of my drawings, models, and other visuals	A.1, A.7, A.8, B.1, B.2, B.3, B.4
DSE_37	Clearly explain the details of my drawings, models, and other visuals	A.1, B.2, B.3, B.4, B.9
DSE_38	Respond to questions without being defensive	A.1, A.8
DSE_39	Use my visuals to explain my design concept	A.1, A.4, B.1, B.2, B.4
DSE_40	Explain my design process from start to finish	A.1, A.4, A.8, B.1, B.4, B.8, D.1, D.2, D.3, D.4, D.5
DSE_41	Describe the design problem that was given to me	A.1, A.2, A.4, A.8, B.1, B.2, B.9
DSE_42	Show the connection between my original concept and my final design	A.2, A.3, A.4, B.1
DSE_43	Use design terminology correctly	A.1, A.3, A.4, A.7, B.1, B.2, B.3, B.4, D.1, D.2, D.3, D.4, D.5
DSE_44	Use language that is appropriate for my audience	A.1, A.4, A.7, A.8, B.1, B.2, B.3, B.4, D.1, D.2, D.3, D.4, D.5
DSE_45	Persuade my audience of why my concept is appropriate for the design problem I was given	A.1, A.2, A.4, A.7, A.8, B.1, B.2, B.3, B.4, B.5, B.6, B.7, B.8, B.9, D.1, D.2, D.3, D.4,
DSE_46	Make my audience believe I am a credible designer	A.1, A.2, A.3, A.4, A.8, B.1, B.2, B.3, B.4, B.5, B.6, B.7, B.8, B.9, B.10, D.1, D.2,
DSE_47	Use professional looking visuals	A.1, A.4, B.1, B.2, B.3, B.4, B.5, B.6, B.7, B.8, B.9
DSE_48	Appear confident	A.1
DSE_49	Reflect on both positives and negatives when responding to questions about my work	A.1, A.2, A.3, A.4
DSE_50	Explain my concept in specific terms	A.1, A.4, B.1, B.2, B.3

Table xx. Design Self-efficacy (DSE) Opertational Structure Connecting Self-effiacacy to National Architectural Accreditation Board (NAAB) Student Performance Criteria (SPC). DSE Items 26-50

Realm	(NAAB) Student Performance Criteria (SPC)
REALM A	A.1 Professional Communication Skills: Ability to write and speak effectively and use representational media appropriate for both within the profession and with the general public.
	A.2 Design Thinking Skills: Ability to raise clear and precise questions, use abstract ideas to interpret information, consider diverse points of view, reach well-reasoned conclusions, and test alternative outcomes against relevant criteria and standards.
	A.3 Investigative Skills: Ability to gather, assess, record, and comparatively evaluate relevant information and performance in order to support conclusions related to a specific project or assignment.
	A.4 Architectural Design Skills: Ability to effectively use basic formal, organizational and environmental principles and the capacity of each to inform two- and three-dimensional design.
	A.5 Ordering Systems: Ability to apply the fundamentals of both natural and formal ordering systems and the capacity of each to inform two- and three-dimensional design.
	A.6 Use of Precedents: Ability to examine and comprehend the fundamental principles present in relevant precedents and to make informed choices about the incorporation of such principles into architecture and urban design projects.
	A.7 History and Global Culture: Understanding of the parallel and divergent histories of architecture and the cultural norms of a variety of indigenous, vernacular, local, and regional settings in terms of their political, economic, social, ecological, and technological factors.
	A.8 Cultural Diversity and Social Equity: Understanding of the diverse needs, values, behavioral norms, physical abilities, and social and spatial patterns that characterize different cultures and individuals and the responsibility of the architect to ensure equity of access to sites, buildings, and structures.

Table xx. National Architectural Accreditation Board (NAAB) Student Performance Criteria (SPC) REALM A


Realm - A
A.1
A.2
A.3
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A.6
A.7
A.8
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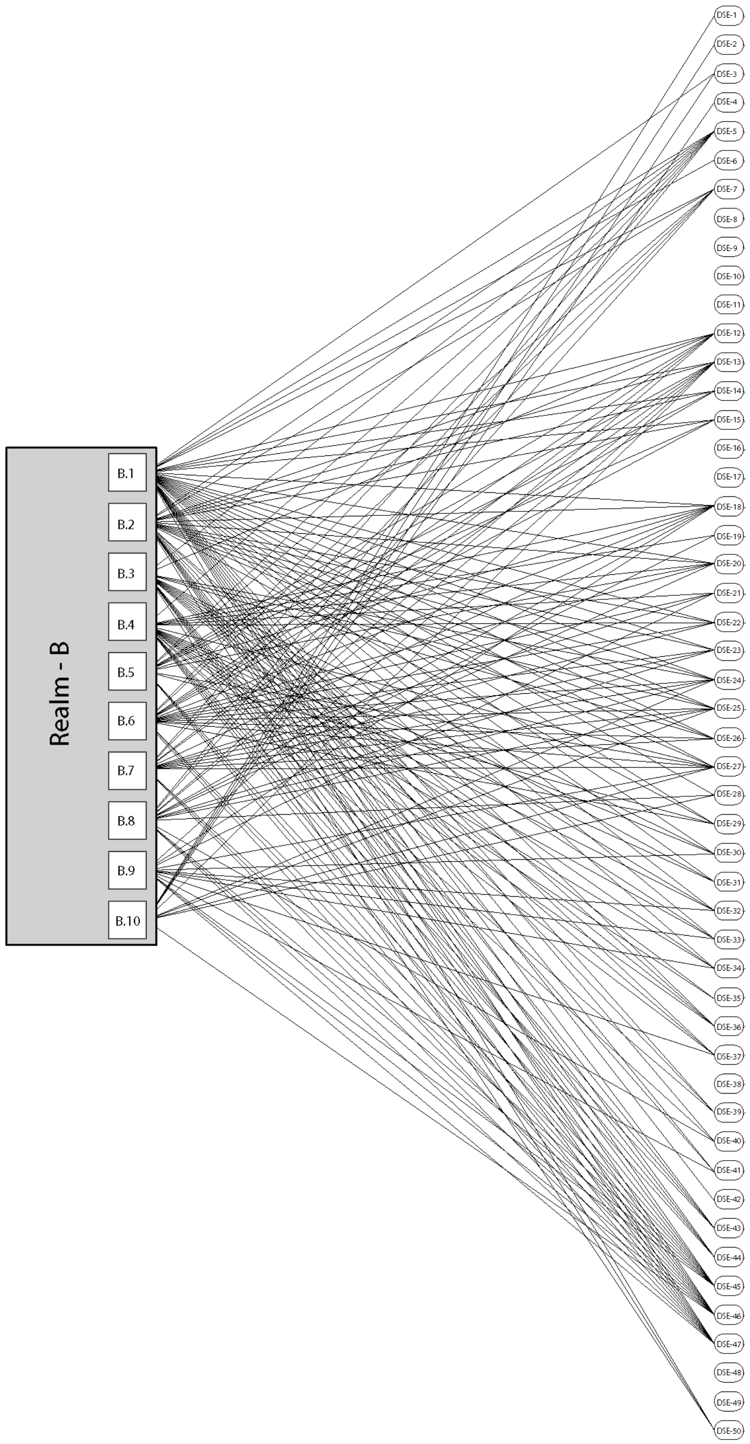
DSE-43
DSE-44
DSE-45
DSE-46
DSE-47
DSE-48
DSE-49
DSE-50

Realm	(NAAB) Student Performance Criteria (SPC)
REALM B	B.1 Pre-Design: Ability to prepare a comprehensive program for an architectural project that includes an assessment of client and user needs; an inventory of spaces and their requirements; an analysis of site conditions (including existing buildings); a review of the relevant building codes and standards, including relevant sustainability requirements, and an assessment of their
	B.2 Site Design: Ability to respond to site characteristics, including urban context and developmental patterning, historical fabric, soil, topography, ecology, climate, and building orientation, in the development of a project design.
	B.3. Codes and Regulations: Ability to design sites, facilities, and systems that are responsive to relevant codes and regulations, and include the principles of life-safety and accessibility standards.
	B.4 Technical Documentation: Ability to make technically clear drawings, prepare outline specifications, and construct models illustrating and identifying the assembly of materials, systems, and components appropriate for a building design.
	B.5 Structural Systems: Ability to demonstrate the basic principles of structural systems and their ability to withstand gravitational, seismic, and lateral forces, as well as the selection and application of the appropriate structural system.
	B.6 Environmental Systems: Ability to demonstrate the principles of environmental systems' design, how design criteria can vary by geographic region, and the tools used for performance assessment. This demonstration must include active and passive heating and cooling, solar geometry, daylighting, natural ventilation, indoor air quality, solar systems, lighting systems, and
	B.7 Building Envelope Systems and Assemblies: Understanding of the basic principles involved in the appropriate selection and application of building envelope systems relative to fundamental performance, aesthetics, moisture transfer, durability, and energy and material resources.
	B.8 Building Materials and Assemblies: Understanding of the basic principles used in the appropriate selection of interior and exterior construction materials, finishes, products, components, and assemblies based on their inherent performance, including environmental impact and reuse.
	B.9 Building Service Systems: Understanding of the basic principles and appropriate application and performance of building service systems, including lighting, mechanical, plumbing, electrical, communication, vertical transportation, security, and fire protection systems.
	B.10 Financial Considerations: Understanding of the fundamentals of building costs, which must include project financing methods and feasibility, construction cost estimating, construction scheduling, operational costs, and life-cycle costs.

Table xx. National Architectural Accreditation Board (NAAB) Student Performance Criteria (SPC) REALM B


Realm - B
B.1
B.2
B.3
B.4
B.5
B.6
B.7
B.8
B.9
B.10
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DSE-3
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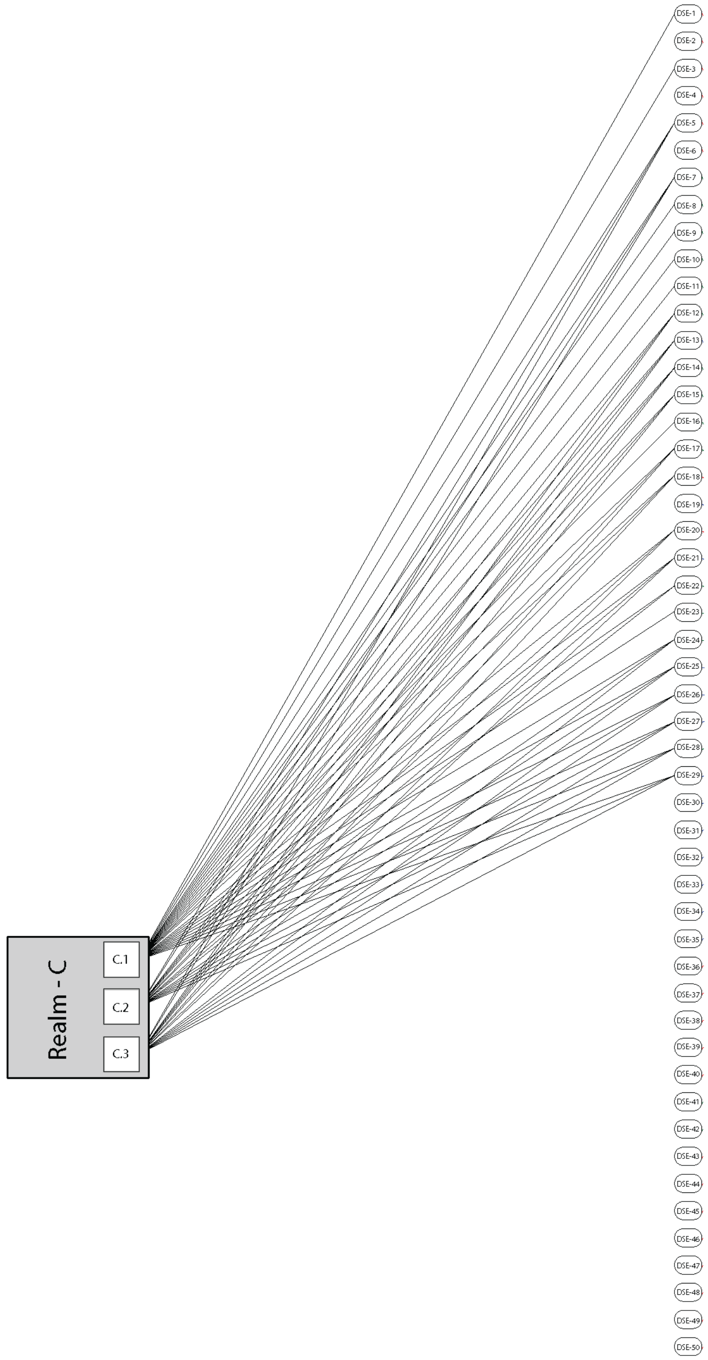
DSE-47
DSE-48
DSE-49
DSE-50

Realm	(NAAB) Student Performance Criteria (SPC)
REALM C	C.1 Research: Understanding of the theoretical and applied research methodologies and practices used during the design process. C.2 Integrated Evaluations and Decision-Making Design Process: Ability to demonstrate the skills associated with making integrated decisions across multiple systems and variables in the completion of a design project. This demonstration includes problem identification, setting evaluative criteria, analyzing solutions, and predicting the effectiveness of implementation. C.3 Integrative Design: Ability to make design decisions within a complex architectural project while demonstrating broad integration and consideration of environmental stewardship, technical documentation, accessibility, site conditions, life safety, environmental systems, structural systems, and building envelope systems and assemblies.

Table xx. National Architectural Accreditation Board (NAAB) Student Performance Criteria (SPC) REALM C


Realm - C
C.1
C.2
C.3
DSE-1
DSE-2
DSE-3
DSE-4
DSE-5
DSE-6
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DSE-8
DSE-9
DSE-10
DSE-11
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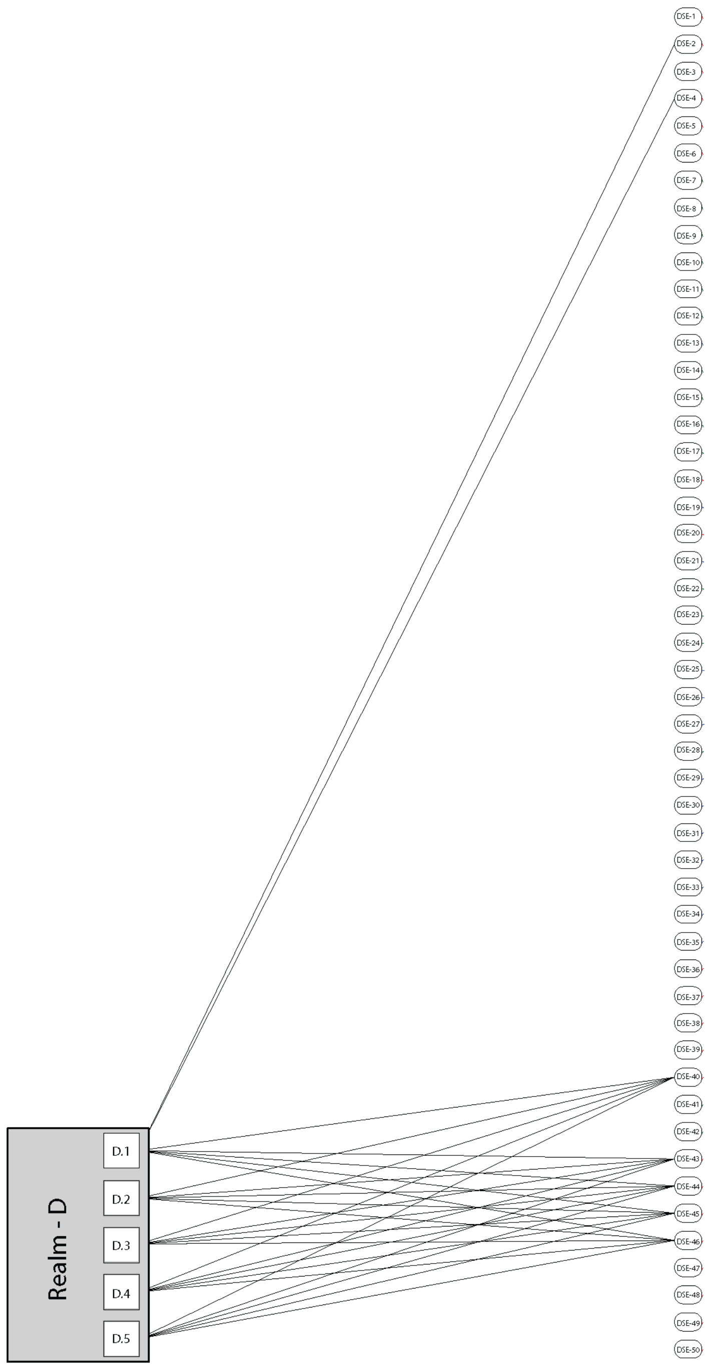
DSE-41
DSE-42
DSE-43
DSE-44
DSE-45
DSE-46
DSE-47
DSE-48
DSE-49
DSE-50

Realm	(NAAB) Student Performance Criteria (SPC)
REALM D	D.1 Stakeholder Roles in Architecture: Understanding of the relationships among key stakeholders in the design process—client, contractor, architect, user groups, local community—and the architect's role to reconcile stakeholder needs. D.2 Project Management: Understanding of the methods for selecting consultants and assembling teams; identifying work plans, project schedules, and time requirements; and recommending project delivery methods. D.3 Business Practices: Understanding of the basic principles of a firm's business practices, including financial management and business planning, marketing, organization, and entrepreneurship. D.4 Legal Responsibilities: Understanding of the architect's responsibility to the public and the client as determined by regulations and legal considerations involving the practice of architecture and professional service contracts. D.5 Professional Conduct: Understanding of the ethical issues involved in the exercise of professional judgment in architectural design and practice and understanding the role of the NCARB Rules of Conduct and the AIA Code of Ethics in defining professional conduct.

Table xx. National Architectural Accreditation Board (NAAB) Student Performance Criteria (SPC) REALM D


Realm - D
D.1
D.2
D.3
D.4
D.5
DSE-1
DSE-2
DSE-3
DSE-4
DSE-5
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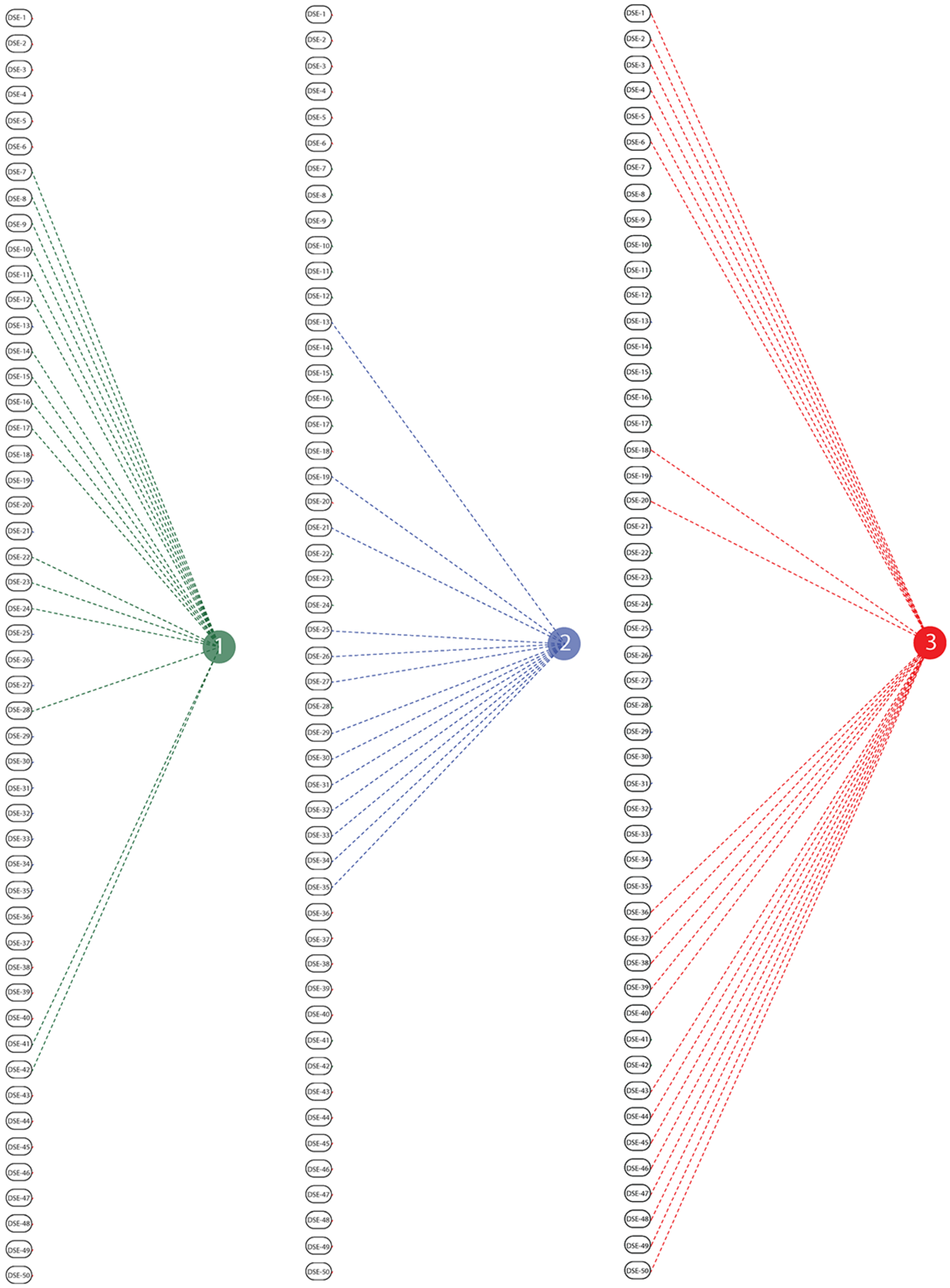
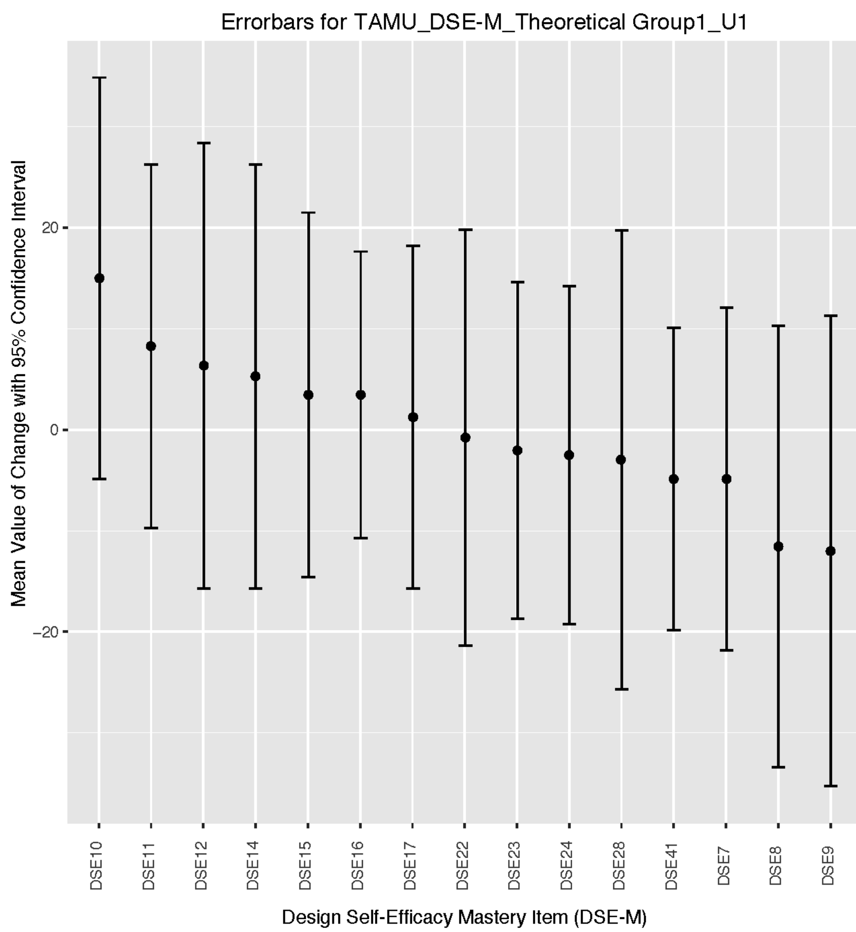
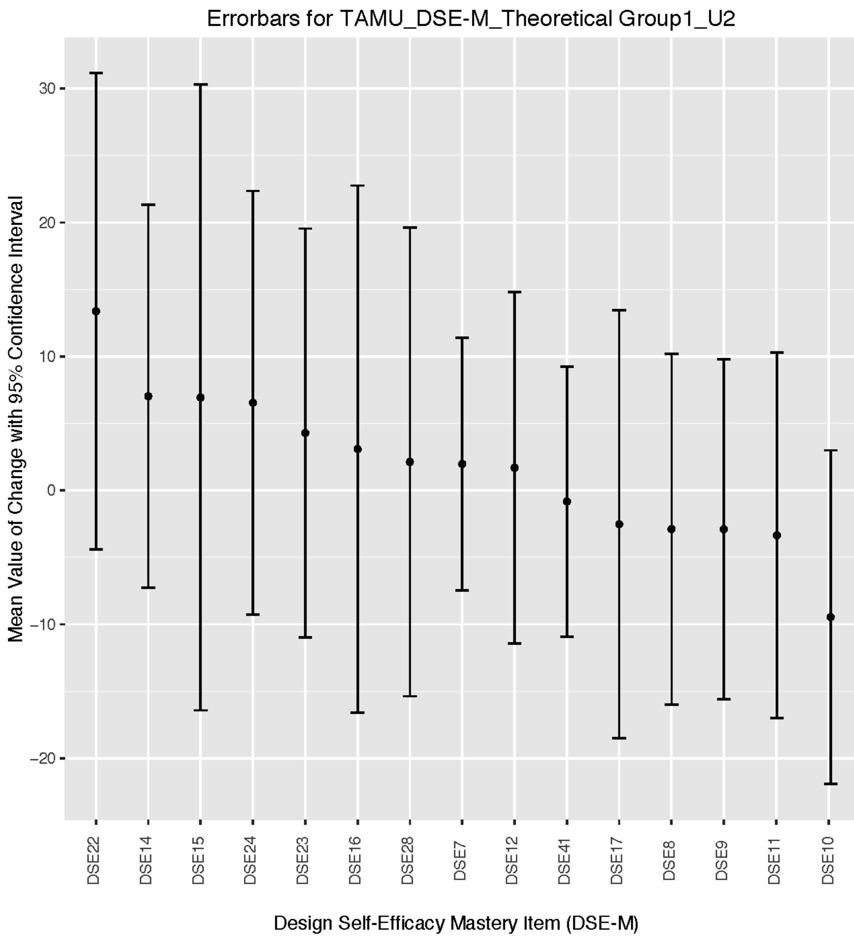
DSE-49
DSE-50


1
2
3

APPENDIX 11

TAMU DSE-M ERROR BARS





Errorbars for TAMU_DSE-M_Theoretical Group1_U2
Mean Value of Change with 95% Confidence Interval
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20
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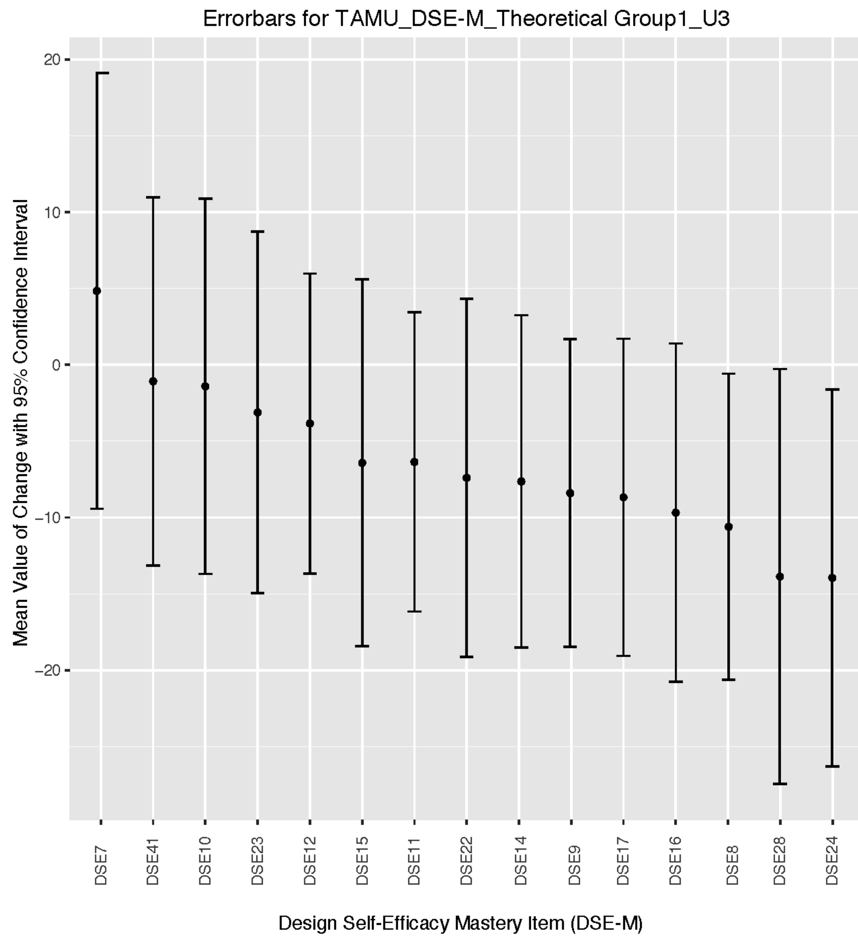
−10
−20
DSE22
DSE14
DSE15
DSE24
DSE23
DSE16
DSE28
DSE7
DSE12
DSE41
DSE17
DSE8
DSE9
DSE11
DSE10
Design Self-Efficacy Mastery Item (DSE-M)


Errorbars for TAMU_DSE-M_Theoretical Group1_U3
Mean Value of Change with 95% Confidence Interval
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10
0
−10
−20
DSE7
DSE41
DSE10
DSE23
DSE12
DSE15
DSE11
DSE22
DSE14
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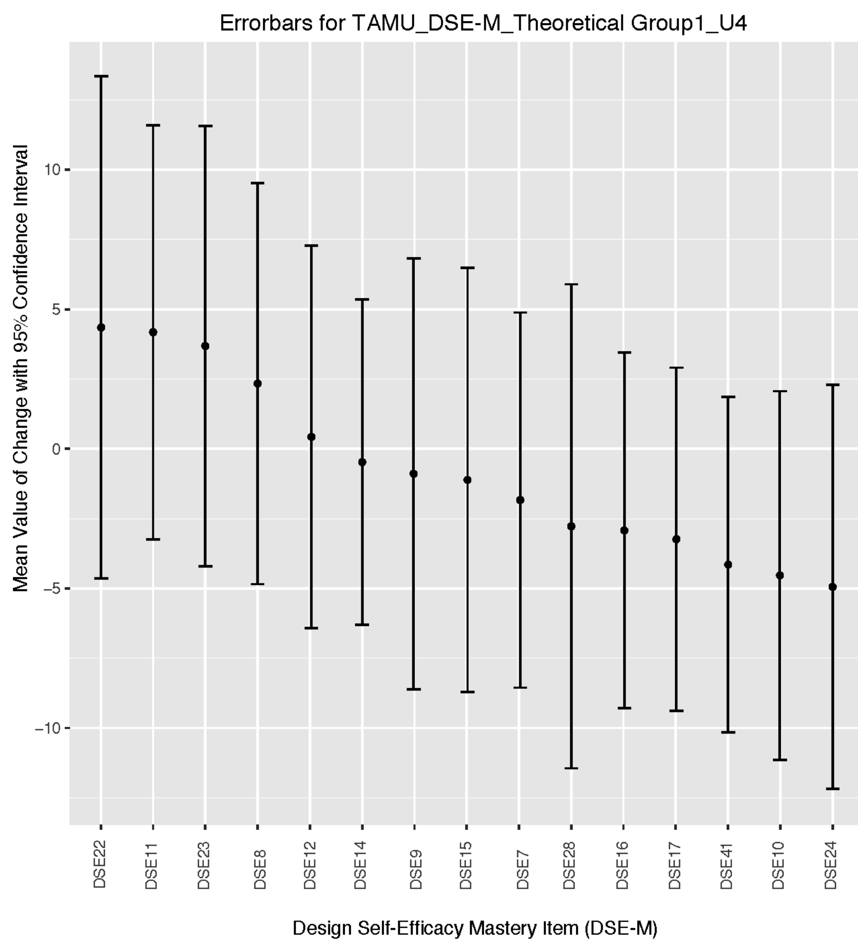
DSE17
DSE16
DSE8
DSE28
DSE24
Design Self-Efficacy Mastery Item (DSE-M)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Mean Value of Change with 95% Confidence Interval
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−5
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DSE23
DSE8
DSE12
DSE14
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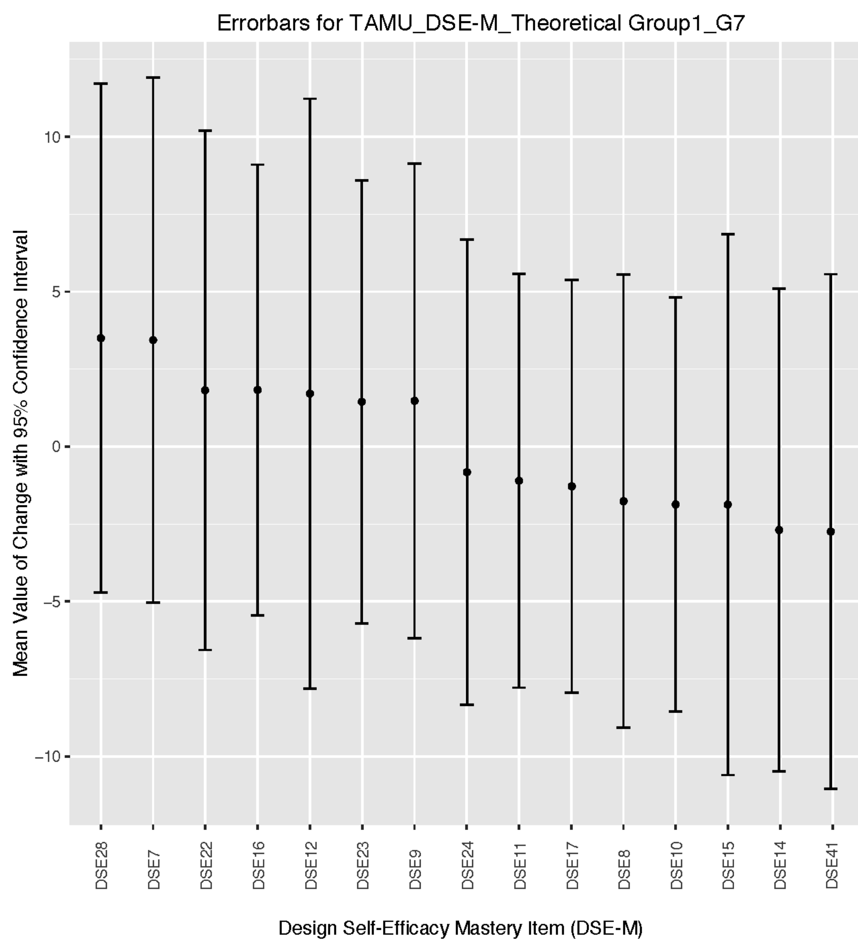
DSE17
DSE41
DSE10
DSE24
Design Self-Efficacy Mastery Item (DSE-M)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Mean Value of Change with 95% Confidence Interval
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−10
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DSE7
DSE22
DSE16
DSE12
DSE23
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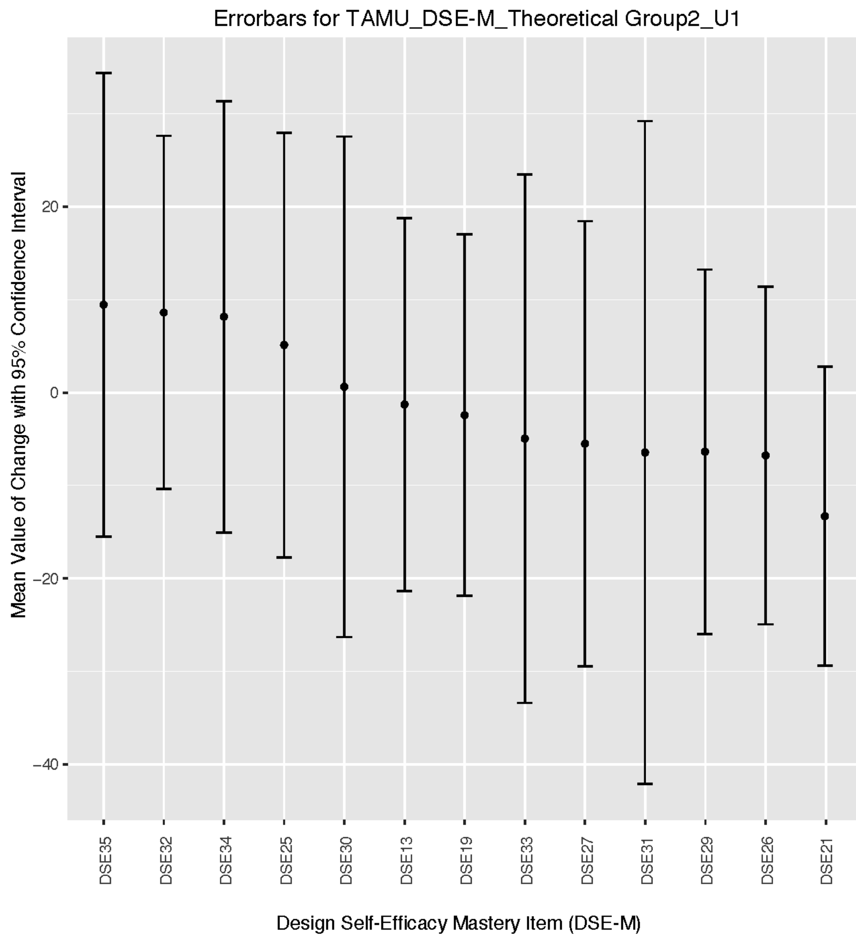
DSE17
DSE8
DSE10
DSE15
DSE14
DSE41
Design Self-Efficacy Mastery Item (DSE-M)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Mean Value of Change with 95% Confidence Interval
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−40
DSE35
DSE32
DSE34
DSE25
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DSE13
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DSE33
DSE27
DSE31
DSE29
DSE26
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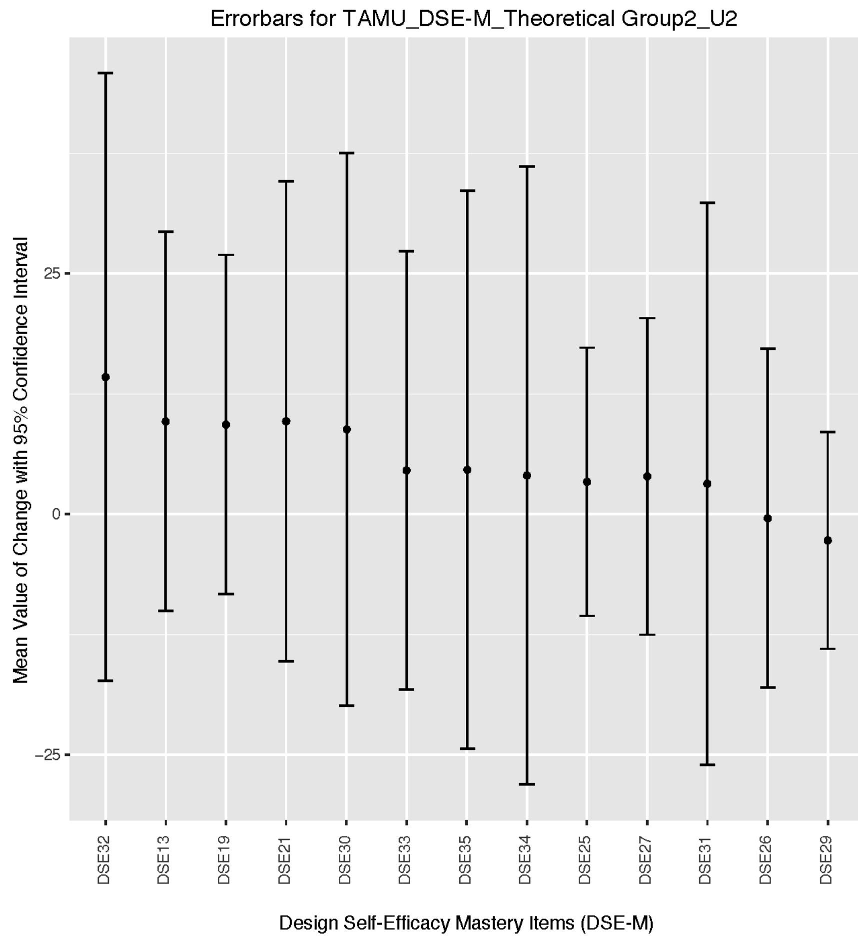
Design Self-Efficacy Mastery Item (DSE-M)



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Mean Value of Change with 95% Confidence Interval
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DSE32
DSE13
DSE19
DSE21
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DSE33
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DSE27
DSE31
DSE26
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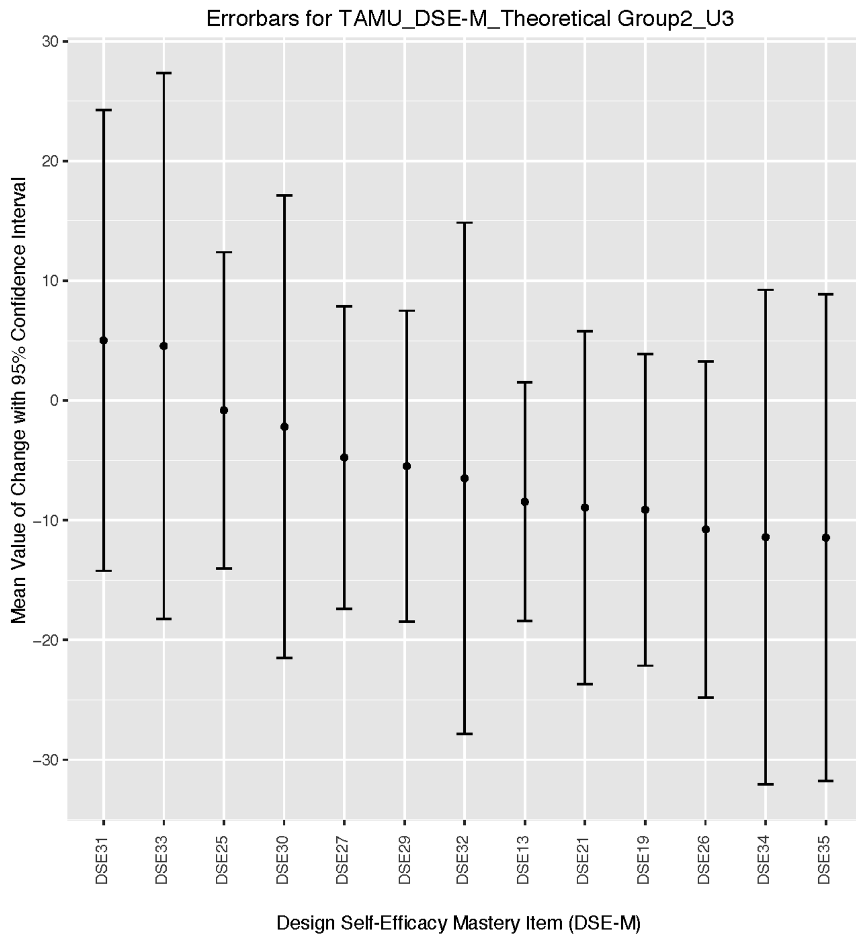
Design Self-Efficacy Mastery Items (DSE-M)


Errorbars for TAMU_DSE-M_Theoretical Group2_U3
Mean Value of Change with 95% Confidence Interval
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10
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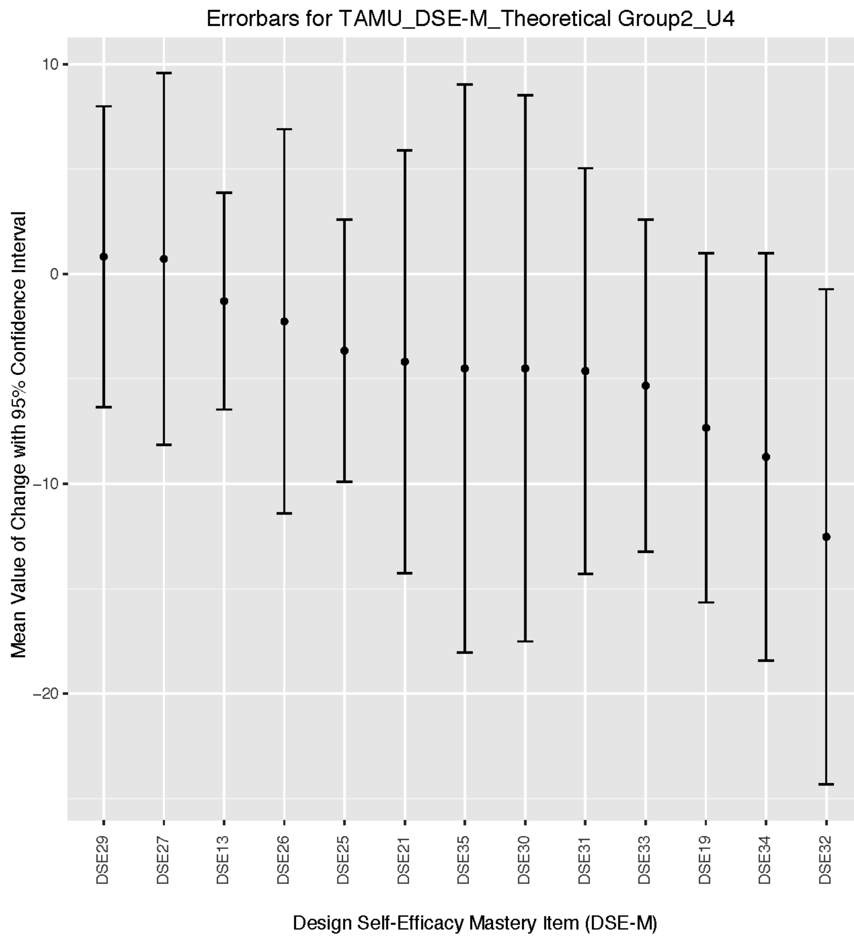
−30
DSE31
DSE33
DSE25
DSE30
DSE27
DSE29
DSE32
DSE13
DSE21
DSE19
DSE26
DSE34
DSE35
Design Self-Efficacy Mastery Item (DSE-M)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DSE25
DSE21
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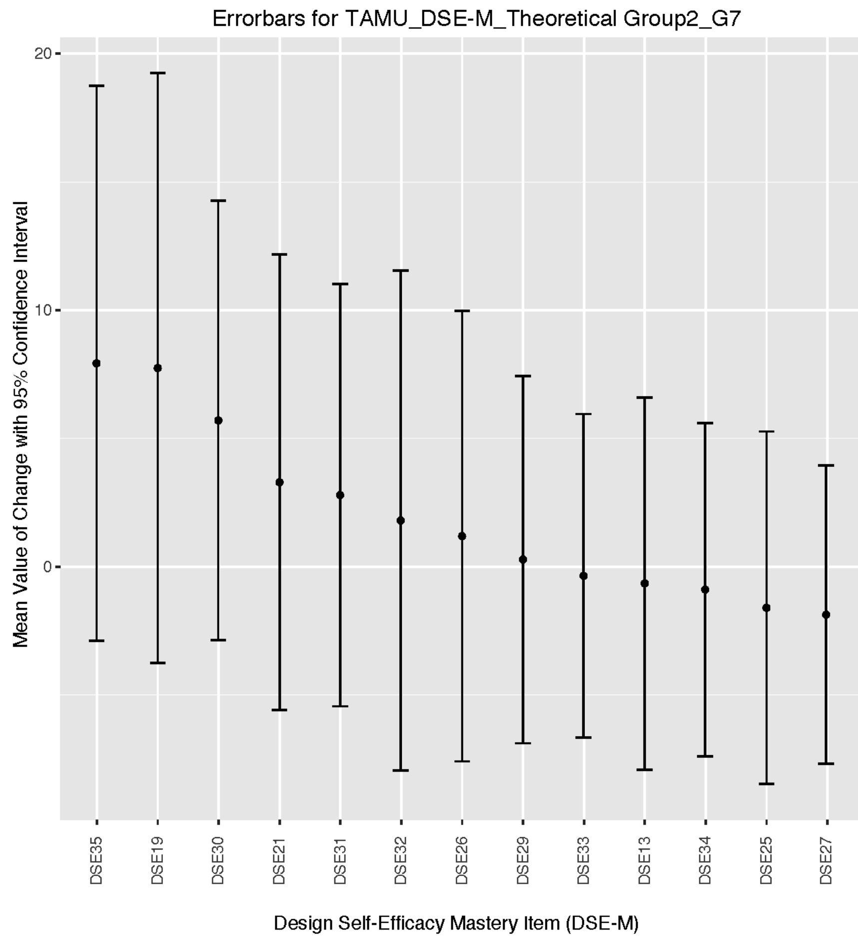
DSE33
DSE19
DSE34
DSE32
Design Self-Efficacy Mastery Item (DSE-M)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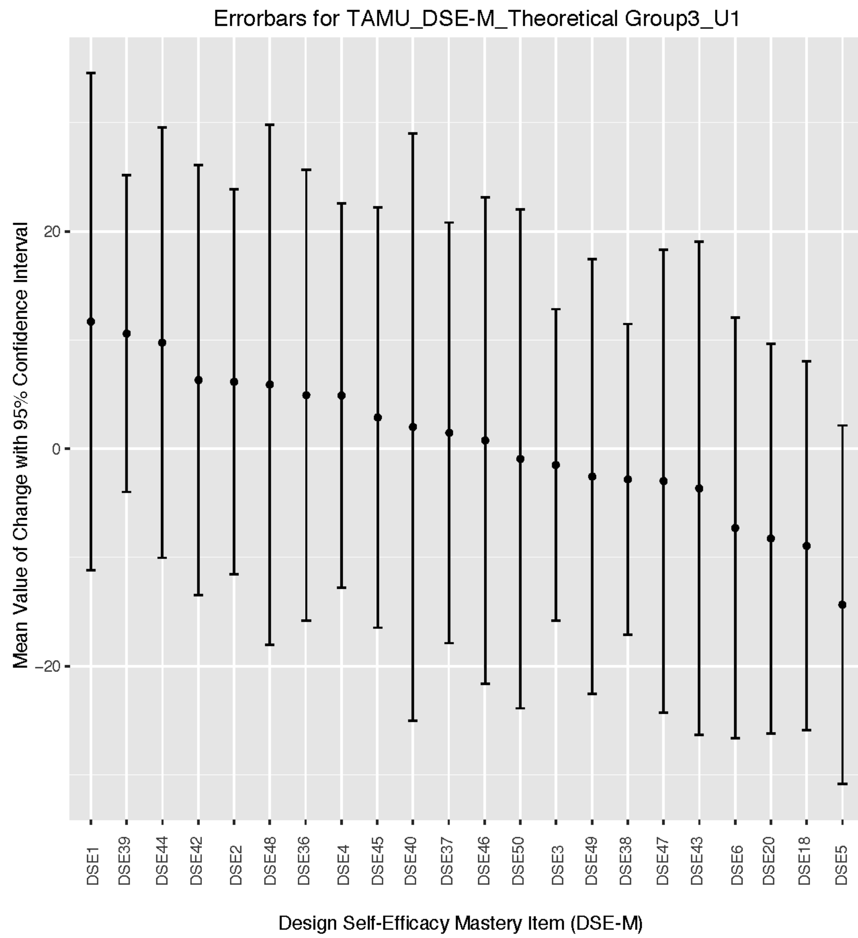
Design Self-Efficacy Mastery Item (DSE-M)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DSE4
DSE45
DSE40
DSE37
DSE46
DSE50
DSE3
DSE49
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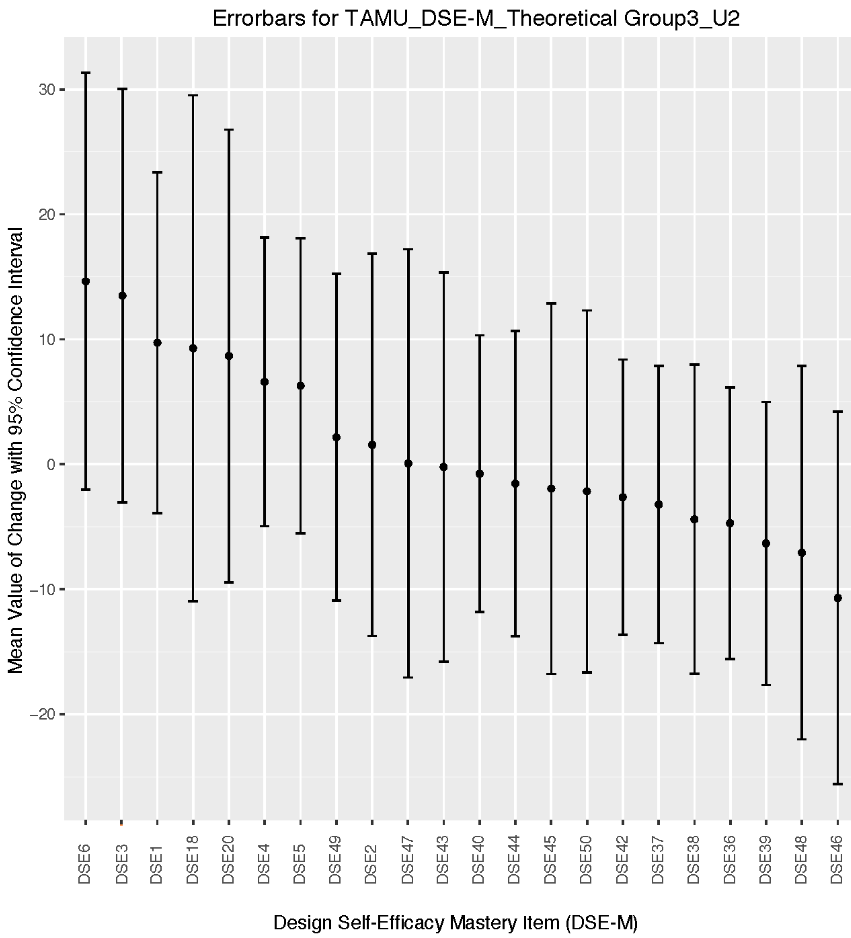
DSE47
DSE43
DSE6
DSE20
DSE18
DSE5
Design Self-Efficacy Mastery Item (DSE-M)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DSE5
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DSE2
DSE47
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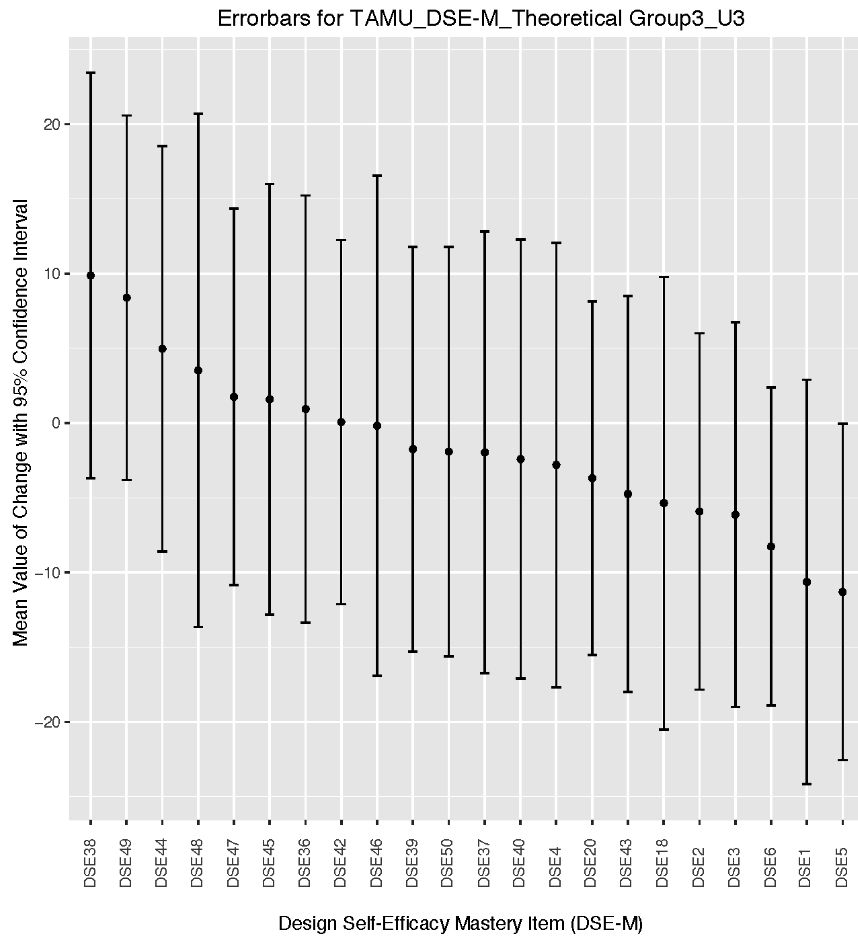
Design Self-Efficacy Mastery Item (DSE-M)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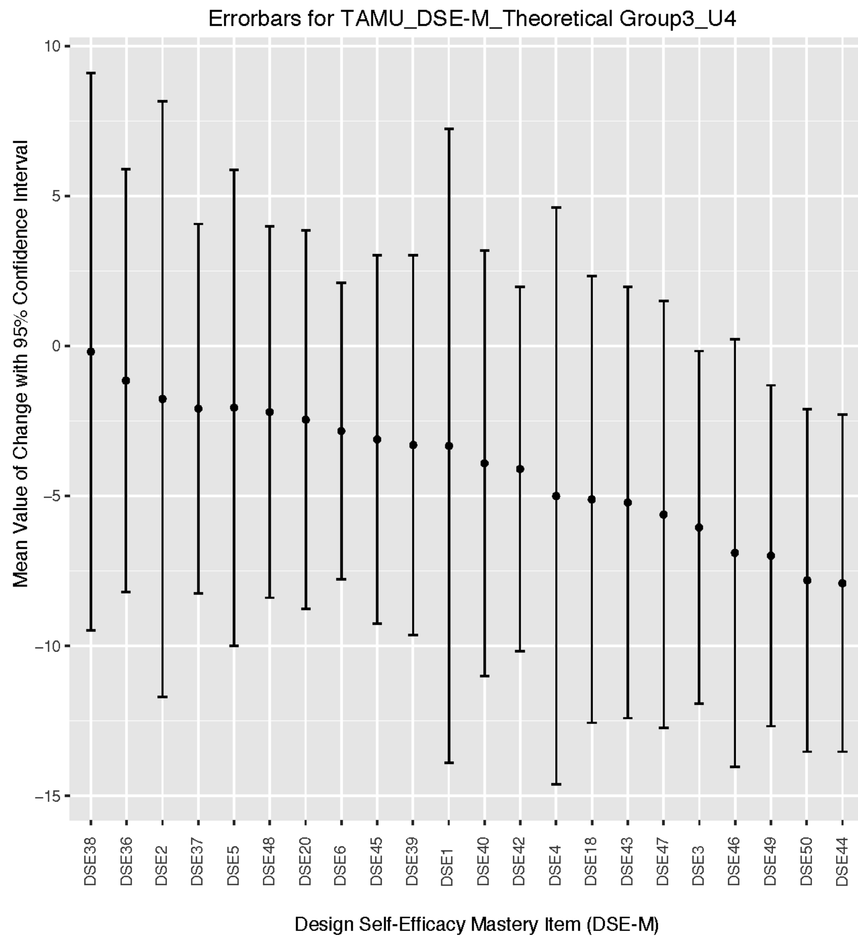
Design Self-Efficacy Mastery Item (DSE-M)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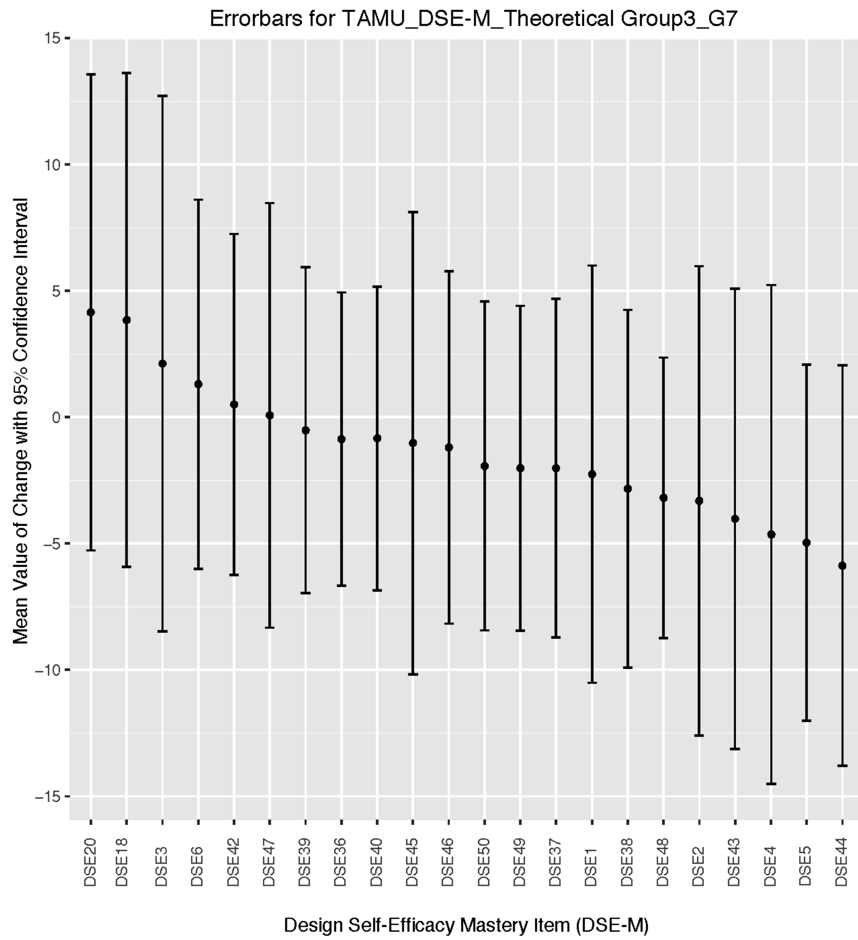
Design Self-Efficacy Mastery Item (DSE-M)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Design Self-Efficacy Mastery Item (DSE-M)

APPENDIX 12

PROJECT SCORING CALL FOR STUDENT PROJECTS

Call For Participation
Measuring Self-Efficacy in the Design Studio Context
External Evaluation of Student Work

You are being invited to take part in a research study entitled: Measuring Self-Efficacy in the Design Studio Context. This research focuses on the self-efficacy of students in design studios. The research is divided into three phases – a pre- and post- semester survey and an external evaluation of your studio work completed this semester. This is a call for participation in the third phase of this research: External Evaluation of Student Work.

You are being invited to take part in this research study because you are a student enrolled in a design studio course. If you participated in our pre- and post- semester survey, thank you for your invaluable responses. Your input is greatly appreciated. Even if you did not participate in the surveys, we encourage you to take part in this phase of the research.

We hope to receive completed surveys and student work from about 350 students, so your participation is important to this research. Of course, you have a choice about whether or not to complete this phase of the research, but if you do participate, you are free to skip any questions or discontinue at any time. Please note, that you should not take part in this study if you are under the age of 18.

The response to the questionnaire will take about 1 minute to complete and will allow you to upload your work for evaluation.

Although you will not get personal benefit from taking part in this research study, your responses may help us to help us to better understand the types of design studios and projects in programs, evaluate interdisciplinary collaboration amongst students in design studio courses, and learn more about a student's ability to communicate their designs to stakeholders both inside and outside of the campus community.

If you do not want to participate, there are no choices other than to decline to participate. If you choose not to participate, we will not collect your work at the end of the semester.

We do not anticipate risks and discomforts beyond those you would normally experience in the course of your daily life and coursework.

Your response to the questionnaire is confidential which means no names will appear or be used on research documents, or be used in presentations or publications. The research Principal Investigator will not know that any information you provided came from you, nor even whether you participated in the study. Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You will not be personally identified in these written materials. We may publish the results of this study; however, we will keep your name and other identifying information private.

Please be aware, while we make every effort to safeguard your data once received from Qualtrics - the online survey/data gathering company, given the nature of online surveys, as with anything involving the Internet, we can never guarantee the confidentiality of the data while still on the survey/data gathering company's servers, or while en route to either them or us. It is also possible the raw data collected for research purposes may be used for marketing or reporting purposes by the survey/data gathering company after the research is concluded, depending on the company's Terms of Service and Privacy policies.

Follow this link to the Survey:
Take the Survey
Or copy and paste the URL below into your Internet browser:
https://uky.az1.qualtrics.com/SE?SID=SV_bHrlPuyhOxFYOxv&Q_CHL=email&Preview=Survey

Student First and Last Name (e.g., John Smith)

University

What is your major?

Studio Course Designation (Please provide the course(s) related to this study from which your work was developed)

What is your current degree level?

What is your home city and state? (e.g., Dallas, TX)

Do you receive Pell Grants as part of your financial aid package?

Please identify your gender.

Please identify your race/ethnicity. Select the closest answer.

In what year were you born?

Artifact Collection Procedures for Students

- De-identification
  - Please provide clean submissions (with no names or identifiers of studio, faculty, or institution)
- File Optimization
  - Please optimize your submission for web viewing (maximum file size is 16MB)
- File Naming Convention
  - UniversityAbbreviation-FirstName-LastName
- UK-John-Doe.PDF
- KU-John-Doe.PDF
- TAMU-John-Doe.PDF

Please attach your file here. Maximum file size is 16MB. If your file is larger than 16MB, please contact Dr. Brandon Combs at bjcomb2@uky.edu for further instructions.

Choose File no file selected

>>

APPENDIX 13

PROJECT SCORING RUBRIC

Design Research - Problem Solving

4 CAPSTONE - 4	3 MILESTONE - 3	2 MILESTONE - 2	1 BENCHMARK - 1
Student demonstrates the ability to construct a clear problem statement, identifies multiple approaches for solving the problem within in a specific context, proposes alternate solutions, examines feasibility of each solution, and implements the solution in a manner that addresses thoroughly and deeply contextual factors.	Student demonstrates the ability to construct a problem statement, identifies multiple approaches for solving the problem, proposes one or more solutions, examines feasibility of each solution, and implements the solution in a manner that addresses contextual factors.	Student demonstrates the ability to construct problem statement but problem statement is superficial, identifies only a single approach for solving the problem, proposes one solution, examines feasibility, and implements the solution in a manner that addresses the problem statement but ignores the contextual factors.	Student demonstrates a limited ability to construct a problem statement, identifies only a single approach for solving the problem but approach is vague, proposes one solution, examination of feasibility is superficial, and implements the solution in a manner that does not directly address the problem statement.

Design Iteration – Data Collection - Analysis

4 CAPSTONE - 4	3 MILESTONE - 3	2 MILESTONE - 2	1 BENCHMARK - 1
Collected data are closely related to the problem statement. The collection methodology is clearly described, rigorous, adequate to the task, and could be replicated by another researcher. Data analysis is clear, thorough, and appropriate to the research. Findings are presented clearly, ignoring unimportant results and highlighting the most significant ones. Conclusions are present, logical, related to the research question, supported by argument and evidence.	Collected data are related to the problem statement. The collection methodology is described and adequate to the task, and could be replicated by another researcher. Data analysis seems appropriate to the research. Findings are presented. Conclusions are present, logical, related to the research question, supported by argument and evidence.	Data is collected but not related to the problem statement. The collection methodology is described but not adequate to the task, and could not be replicated by another researcher. Data analysis is attempted Findings are presented. Conclusions are present but lack direct alignment to the research question.	Data are not collected or examined, or are insufficient and/or irrelevant to the problem statement. Data collection method is either not described, unclear, or biased. Data analysis is missing, unclear, simplistic, or biased. Analysis is unrepresentatively selective or unrelated to the research question. Conclusions are missing, unclear, illogical, irrelevant to the research question, or unsupported by argument or evidence

Data Evaluation - Integrative Learning

4 — CAPSTONE - 4

Meaningfully synthesizes connections among experiences to deepen understanding of fields of study. Draws conclusions by combining examples, facts, theories, or methodologies from more than one field of study, and applies skills learned to solve difficult problems or explore complex issues in original ways.

3 — MILESTONE - 3

Selects and develops examples of life experiences from various experiences. Identifies concepts / theories / frameworks of fields of study. Independently connects examples, facts, or theories and applies skills gained to solve problems or explore issues.

2 — MILESTONE - 2

Compares life experiences and academic knowledge to infer similarities/differences, and acknowledge external perspectives. When prompted connects examples, facts, or theories. Uses skills to contribute to understanding of problems or issues.

1 — BENCHMARK - 1

Identifies connections between life experience, academic texts, and ideas perceived as similar to own interests. When prompted presents examples, facts, or theories from at least one field of study. Uses basic skills in a new situation.

Communication – Written Presentation

4 — CAPSTONE - 4

Student demonstrates thorough understanding of context, audience, and purpose in response to the assigned task(s). Uses appropriate, relevant, and compelling content to illustrate mastery of the subject. Demonstrates attention to detail through successful execution of specific writing task(s). Demonstrates correct use of high quality, credible sources to support work.

3 — MILESTONE - 3

Demonstrates adequate understanding of context, audience, and purpose in response to the assigned task(s). Uses appropriate, relevant, and compelling content to explore ideas of the subject. Demonstrates consistent use of important conventions in the execution of the writing task(s), including organization, content, presentation, and stylistic choices. Demonstrates consistent use of credible sources to support work.

2 — MILESTONE - 2

Demonstrates awareness of content, audience, and purpose in response to the assigned task(s). Uses appropriate and relevant content development to explore ideas through most of the work. Follows expectations appropriate to the writing task(s). Demonstrates an attempt to use credible and/or relevant sources to support work.

1 — BENCHMARK - 1

Demonstrates minimal attention to context, audience, purpose, and to the assigned task(s). Uses appropriate and relevant content to develop simple ideas in some parts of the work. Attempts to use consistent system for basic organization and presentation. Demonstrates and attempt to use sources to support ideas in the writing.

Communication – Graphic / Visual Presentation

4 CAPSTONE - 4	3 MILESTONE - 3	2 MILESTONE - 2	1 BENCHMARK - 1
Student demonstrates adherence to assignment's specifications and an in-depth understanding of the content. Student provides valid and/or reasonable conclusions. Graphics and content are easily viewed and identified from the audience seating. Displays high quality and excellent technique in drawings, graphics, photos, designs, video, etc. Unifies elements using repeated motifs, graphic elements, connection to text, etc. Employs appropriate contrasts (e.g., color, fonts, sizes). Aligns graphic elements and space appropriately.	Student demonstrates adherence to assignment's specifications and basic understanding of the content. Student provides conclusions. Graphics and content are easily viewed and identified from the audience seating. Displays adequate technique in drawings, graphics, photos, designs, video, etc. Unifies elements using repeated motifs, graphic elements, connection to text, etc. Employs contrasts (e.g., color, fonts, sizes). Aligns graphic elements and space appropriately	Student demonstrates limited adherence to assignment's specifications and basic understanding of the content. Student provides basic conclusions. Graphics and content are difficult to view and identify from the audience seating. Displays adequate technique in some drawings, graphics, photos, designs, video, etc. Unifies elements using motifs, graphic elements, connection to text, etc. Employs contrasts (e.g., color, fonts, sizes). Aligns graphic elements and space appropriately.	Student lacks adherence to assignment's specifications and basic understanding of the content. Student provides superficial conclusions. Graphics and content are cannot be viewed or identified from the audience seating. Displays inadequate technique in drawings, graphics, photos, designs, video, etc. Student does not employ contrasts well (e.g., color, fonts, sizes). Alignments for graphic elements and spacing are missing.

APPENDIX 14

UKY IRB APPROVAL #14-0993-24B

UK
UNIVERSITY OF
KENTUCKY

Office of Research Integrity
IRB, IACUC, RDRC
315 Kinkead Hall
Lexington, KY 40506-0057
859 257-9428
fax 859 257-8995
www.research.uky.edu/ori/

EXEMPTION CERTIFICATION

MEMO: Gregory Luhan
Architecture
117 Pence Hall
Campus 0041
PI phone #: (859)257-6568

FROM: Institutional Review Board
c/o Office of Research Integrity

SUBJECT: Exemption Certification for Protocol No. 14-0993-X4B

DATE: January 21, 2015

On January 16, 2015, it was determined that your project entitled, *Interdisciplinary Exchanges in a Design Studio Context: Student Efficacy and Knowledge Transfer*, meets federal criteria to qualify as an exempt study.

Because the study has been certified as exempt, you will not be required to complete continuation or final review reports. However, it is your responsibility to notify the IRB prior to making any changes to the study. Please note that changes made to an exempt protocol may disqualify it from exempt status and may require an expedited or full review.

The Office of Research Integrity will hold your exemption application for six years. Before the end of the sixth year, you will be notified that your file will be closed and the application destroyed. If your project is still ongoing, you will need to contact the Office of Research Integrity upon receipt of that letter and follow the instructions for completing a new exemption application. It is, therefore, important that you keep your address current with the Office of Research Integrity.

For information describing investigator responsibilities after obtaining IRB approval, download and read the document "PI Guidance to Responsibilities, Qualifications, Records and Documentation of Human Subjects Research" from the Office of Research Integrity's IRB Survival Handbook web page [http://www.research.uky.edu/ori/IRB-Survival-Handbook.html#PIresponsibilities]. Additional information regarding IRB review, federal regulations, and institutional policies may be found through ORI's web site [http://www.research.uke.edu/ori]. If you have questions, need additional information, or would like a paper copy of the above mentioned document, contact the Office of Research Integrity at (859) 257-9428.

APPENDIX 15

TAMU IRB APPROVAL #2015-0860D

DIVISION OF RESEARCH

TEXAS A&M UNIVERSITY

DATE: January 22, 2016

MEMORANDUM

TO: Mark J Clayton
TAMU - College Of Architecture - Architecture

FROM: Dr. James Fluckey
Chair, TAMU IRB

SUBJECT: Expedited Approval

Study Number:	IRB2015-0860D
Title:	Measuring Self-efficacy in the Design Studio Context | The Impact of Studio Type and Project Type
Date of Determination:	
Approval Date:	01/22/2016
Continuing Review Due:	12/15/2016
Expiration Date:	01/15/2017
Documents Reviewed and Approved:	Only IRB-stamped approved versions of study materials (e.g., consent forms, recruitment materials, and questionnaires) can be distributed to human participants. Please log into iRIS to download the stamped, approved version of all study materials. If you are unable to locate the stamped version in iRIS, please contact the iRIS Support Team at 979.845.4969 or the IRB liaison assigned to your area.

Submission Components			
Study Document			
Title	Version Number	Version Date	Outcome
luhan_10-tamu_nonmed_appendix_g-letterofsupport-wardwells(08132015final)	Version 1.0	12/20/2015	Approved
luhan_09-tamu_nonmed_appendix_f-student_survey(12152015-final)	Version 1.0	12/20/2015	Approved
luhan_08-tamu_nonmed_appendix-e_assignmentrubric(12152015-final)	Version 1.0	12/20/2015	Approved
luhan_07-tamu_nonmed_appendix-d2_facultyindividualinterview-interviewprotocol(12152015-final)	Version 1.0	12/20/2015	Approved

750 Agronomy Road, Suite 2701
1186 TAMU
College Station, TX 77843-1186
Tel. 979.458.1467 Fax. 979.862.3176
http://rcb.tamu.edu

luhan_06-tamu_nonmed_appendix-d1_facultyfocusgroup-interviewprotocol(12152015-final)	Version 1.0	12/20/2015	Approved
luhan_05-tamu_nonmed_appendix-c_coverletter(12012015-final)	Version 1.0	12/20/2015	Approved
luhan_02-tamu_nonmed_appendix-a2_studentrecruitment(12152015-final)	Version 1.0	12/20/2015	Approved
luhan_01-tamu_nonmed_appendix-a1_facultyrecruitment(12152015-final)	Version 1.0	12/20/2015	Approved
Study Consent Form			
Title	Version Number	Version Date	Outcome
LUHAN_04-TAMU_NonMed_Appendix-B2_StudentConsent(01212016-FINAL)	Version 2.0	01/21/2016	Approved
LUHAN_03-TAMU-NonMed_Appendix-B1_FacultyConsent(01042016-FINAL)	Version 2.0	01/05/2016	Approved

Document of Consent: Written consent in accordance with 45 CF 46.116/ 21 CFR 50.27

Comments:

- This study is approved for 750 participants.
- Research is to be conducted according to the study application approved by the IRB prior to implementation.
- Any future correspondence should include the IRB study number and the study title.

Investigators assume the following responsibilities:

1. **Continuing Review:** The study must be renewed by the expiration date in order to continue with the research. A Continuing Review application along with required documents must be submitted by the continuing review deadline. Failure to do so may result in processing delays, study expiration, and/or loss of funding.
2. **Completion Report:** Upon completion of the research study (including data collection and analysis), a Completion Report must be submitted to the IRB.
3. **Unanticipated Problems and Adverse Events:** Unanticipated problems and adverse events must be reported to the IRB immediately.
4. **Reports of Potential Non-compliance:** Potential non-compliance, including deviations from protocol and violations, must be reported to the IRB office immediately.
5. **Amendments:** Changes to the protocol and/or study documents must be requested by submitting an

Amendment to the IRB for review. The Amendment must be approved by the IRB before being implemented.

6. **Consent Forms:** When using a consent form or information sheet, the IRB stamped approved version must be used. Please log into iRIS to download the stamped approved version of the consenting instruments. If you are unable to locate the stamped version in iRIS, please contact the iRIS Support Team at 979.845.4969 or the IRB liaison assigned to your area. Human participants are to receive a copy of the consent document, if appropriate.
7. **Post Approval Monitoring:** Expedited and full board studies may be subject to post approval monitoring. During the life of the study, please review and document study progress using the PI self-assessment found on the RCB website as a method of preparation for the potential review. Investigators are responsible for maintaining complete and accurate study records and making them available for post approval monitoring. Investigators are encouraged to request a pre-initiation site visit with the Post Approval Monitor. These visits are designed to help ensure that all necessary documents are approved and in order prior to initiating the study and to help investigators maintain compliance.
8. **Recruitment**: All approved recruitment materials will be stamped electronically by the HRPP staff and available for download from iRIS. These IRB-stamped approved documents from iRIS must be used for recruitment. For materials that are distributed to potential participants electronically and for which you can only feasibly use the approved text rather than the stamped document, the study's IRB Study Number, approval date, and expiration dates must be included in the following format: TAMU IRB#20XX-XXXX Approved: XX/XX/XXXX Expiration Date: XX/XX/XXXX.
9. **FERPA and PPRA:** Investigators conducting research with students must have appropriate approvals from the FERPA administrator at the institution where the research will be conducted in accordance with the Family Education Rights and Privacy Act (FERPA). The Protection of Pupil Rights Amendment (PPRA) protects the rights of parents in students ensuring that written parental consent is required for participation in surveys, analysis, or evaluation that ask questions falling into categories of protected information.
10. **Food:** Any use of food in the conduct of human research must follow Texas A&M University Standard Administrative Procedure 24.01.01.M4.02.
11. **Payments:** Any use of payments to human research participants must follow Texas A&M University Standard Administrative Procedure 21.01.99.M0.03.
12. **Records Retention**: Federal Regulations require records be retained for at least 3 years. Records of a study that collects protected health information are required to be retained for at least 6 years. Some sponsors require extended records retention. Texas A&M University rule 15.99.03.M1.03 Responsible Stewardship of Research Data requires that research records be retained on Texas A&M property.

This electronic document provides notification of the review results by the Institutional Review Board.

APPENDIX 16

UKY IRB APPROVAL #15-0680-P4S

UNIVERSITY OF KENTUCKY

Office of Research Integrity
IRB, IACUC, RDRC
315 Kinkead Hall
Lexington, KY 40506-0057
859 257-9428
fax 859 257-8995
www.research.uky.edu/ori/

Initial Review

Approval Ends
January 17, 2017

IRB Number
15-0680-P4S

TO: Gregory Luhan
Architecture
117 Pence Hall
Campus 0041
PI phone #: (859) 257-6568

FROM: Chairperson/Vice Chairperson
Non-medical Institutional Review Board (IRB)

SUBJECT: Approval of Protocol Number 15-0680-P4S

DATE: January 26, 2016

On January 19, 2016, the Non-medical Institutional Review Board approved your protocol entitled:

Measuring Self-Efficacy in the Context of an Architectural Design Studio

Approval is effective from January 19, 2016 until January 17, 2017 and extends to any consent/assent form, cover letter, and/or phone script. If applicable, attached is the IRB approved consent/assent document(s) to be used when enrolling subjects. **[Note, subjects can only be enrolled using consent/assent forms which have a valid "IRB Approval" stamp unless special waiver has been obtained from the IRB.]** Prior to the end of this period, you will be sent a Continuation Review Report Form which must be completed and returned to the Office of Research Integrity so that the protocol can be reviewed and approved for the next period.

In implementing the research activities, you are responsible for complying with IRB decisions, conditions and requirements. The research procedures should be implemented as approved in the IRB protocol. It is the principal investigators responsibility to ensure any changes planned for the research are submitted for review and approval by the IRB prior to implementation. Protocol changes made without prior IRB approval to eliminate apparent hazards to the subject(s) should be reported in writing immediately to the IRB. Furthermore, discontinuing a study or completion of a study is considered a change in the protocol's status and therefore the IRB should be promptly notified in writing.

For information describing investigator responsibilities after obtaining IRB approval, download and read the document "PI Guidance to Responsibilities, Qualifications, Records and Documentation of Human Subjects Research" from the Office of Research Integrity's IRB Survival Handbook web page [http://www.research.uky.edu/ori/IRB-Survival-Handbook.html#PIresponsibilities]. Additional information regarding IRB review, federal regulations, and institutional policies may be found through ORI's web site [http://www.research.uky.edu/ori]. If you have questions, need additional information, or would like a paper copy of the above mentioned document, contact the Office of Research Integrity at (859) 257-9428.

N. Van Tubergen, PhD/ah
Chairperson/Vice Chairperson

IRB Approval
15-0680
THIS FORM VALID
1/19/16 – 1/17/17

Consent to Participate in a Research Study

MEASURING SELF-EFFICACY IN THE DESIGN STUDIO CONTEXT

WHY ARE YOU BEING INVITED TO TAKE PART IN THIS RESEARCH?

You are being invited to take part in a research study about the self-efficacy of students enrolled in design studios. This research will help us to better understand: the types of design studios, the types of projects, a rubric for assessing a project score, the level of collaboration amongst students in design studio courses, the ability of a student to communicate their designs to stakeholders both inside and outside of the campus community, and their influence on student self-efficacy. You are being invited to take part in this research study because you are a student enrolled in a design studio course in the College of Design at the University of Kentucky. If you volunteer to take part in this study, you will be one of about 350 at the University of Kentucky.

WHO IS DOING THE STUDY?

The person in charge of this study is Gregory A. Luhan, the John Russell Groves Endowed Professor Architecture of the University of Kentucky, College of Design - School of Architecture and a PhD Student at the College of Architecture at Texas A&M University. He will serve as the Principal Investigator for the research study.

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of this research is to study student self-efficacy in design studios. By doing this study, the Principal Investigator hopes to better understand the types of design studios and projects in use today; be able to evaluate the degree and kind of collaboration amongst students in design studio courses, and learn more about a student's ability to communicate their designs to stakeholders both inside and outside of the campus community.

ARE THERE REASONS WHY YOU SHOULD NOT TAKE PART IN THIS STUDY?

You should not take part in this study if you are under the age of 18.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST?

The research procedures will be conducted at the University of Kentucky, College of Design studio facilities in Pence Hall, Miller Hall, Bowman Hall, and Funkhouser Buildings. The study will take place during your usual class time.

WHAT WILL YOU BE ASKED TO DO?

You will be asked to complete an online consent form. You will be complete a brief 10-minute survey that measures your self-efficacy and self-report a disposition for collaboration score using a well-established instrument available on the Web that will be linked to our online survey. This procedure will be repeated three times over the course of the semester (pre-test at the beginning of the semester, post-test at or about midterm review, and post-test, at or about final review). Your survey responses will be linked to results of a project scoring rubric and your demographic data and compiled by an honest data broker who will de-identify the data for analysis by the principal investigator. Your participation in this study will last up to 30-45 minutes over the course of the entire spring semester.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

We do not anticipate risks and discomforts beyond those you would normally experience in the course of your daily life and coursework.

WILL YOU BENEFIT FROM TAKING PART IN THIS STUDY?

You will receive no direct benefit from taking part in this study. Your participation may benefit future design student to the extent that our study can help improve design education.

DO YOU HAVE TO TAKE PART IN THE STUDY?

If you decide to take part in the study, it should be because you really want to participate. You will not lose any benefits or rights you would normally have if you choose not to participate. You can stop at any time during the study and still keep the benefits and rights you had before participating. As a student, if you decide not to take part in this study, your choice will have no effect on your academic status or grade in the class.

IF YOU DON'T WANT TO TAKE PART IN THE STUDY, ARE THERE OTHER CHOICES?

If you do not want to participate, there are no choices other than to decline to participate. If you choose not to participate, we will not collect your work at the end of the semester.

WHAT WILL IT COST YOU TO PARTICIPATE?

There are no costs associated with taking part in the study.

WILL YOU RECEIVE ANY REWARDS FOR TAKING PART IN THIS STUDY?

You will not receive any rewards or payment for taking part in the study.

WHO WILL SEE THE INFORMATION THAT YOU GIVE?

We will keep private all research records that identify you to the extent allowed by law. People who have access to your information include the Principal Investigator and research study personnel, however, any information that is sent to them will be coded with a number so that they cannot tell whom you are. Research records will be stored securely and only the data broker / "Honest Broker" in Student Services will have access to the survey results, project scoring, the linked data, and the research records. The honest broker is the only person who can see information that is linked to you and has your name on it. If there are any reports about this study, your name will not be in them. The University of Kentucky College of Design in addition to proposed research plan might use the aggregated results of the research internally. No identifiers linking you to this study will be included in any sort of report that might be published.

However, there are some circumstances in which we may have to show your information to other people. For example, the law may require us to show your information to a court or to tell authorities if you report information about a child being abused or if you pose a danger to yourself or someone else. Also, we may be required to show information which identifies you to people who need to be sure we have done the research correctly; these would be people from such organizations as the University of Kentucky.

Your information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You will not be personally identified in these written materials. We may publish the results of this study; however, we will keep your name and other identifying information private.

Please be aware, while we make every effort to safeguard your data once received from the online survey/data gathering company, given the nature of online surveys, as with anything involving the Internet, we can never guarantee the confidentiality of the data while still on the survey/data gathering company's servers, or while en route to either them or us. It is also possible the raw data collected for research purposes may be used for marketing or reporting purposes by the survey/data gathering company after the research is concluded, depending on the company's Terms of Service and Privacy policies.

CAN YOUR TAKING PART IN THE STUDY END EARLY?

If you decide to take part in the study you still have the right to decide at any time that you no longer want to continue. You will not be treated differently if you decide to stop taking part in the study. If you decide you no longer wish to be part of the study, please notify the Principal Investigator of the research team.

WHAT ELSE DO YOU NEED TO KNOW?

There is a possibility that the data collected from you may be shared with other investigators in the future. If that is the case the data will not contain information that can identify you unless you give your consent or the UK Institutional Review Board (IRB) approves the research. The IRB is a committee that reviews ethical issues, according to federal, state, and local regulations on research with human subjects, to make sure the study complies with these before approval of a research study is issued.

WHAT IF YOU HAVE QUESTIONS, SUGGESTIONS, CONCERNS, OR COMPLAINTS?

Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions, suggestions, concerns, or complaints about the study, you can contact the Principal Investigator Professor Gregory Luhan via telephone at 859.257.6568 or by e-mail: gregory.luhan@uky.edu. If you have any questions about your rights as a volunteer in this research, contact the staff in the Office of Research Integrity at the University of Kentucky between the business hours of 8am and 5pm EST, Mon-Fri. at 859-257-9428 or toll free at 1-866-400-9428.

Consent to Participate in a Research Study

MEASURING SELF-EFFICACY IN THE DESIGN STUDIO CONTEXT

WHY ARE YOU BEING INVITED TO TAKE PART IN THIS RESEARCH?

You are being invited to take part in a research study about the self-efficacy of students enrolled in design studios. This research will help us to better understand: the types of design studios, the types of projects, a rubric for assessing a project score, the level of collaboration amongst students in design studio courses, the ability of a student to communicate their designs to stakeholders both inside and outside of the campus community, and their influence on student self-efficacy. You are being invited to take part in this research study because you are a faculty member teaching in a design studio course in the College of Design at the University of Kentucky.

WHO IS DOING THE STUDY?

The person in charge of this study is Gregory A. Luhan, the John Russell Groves Endowed Professor Architecture of the University of Kentucky, College of Design - School of Architecture and a PhD Student at the College of Architecture at Texas A&M University. He will serve as the Principal Investigator for the research study.

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of this study is to study student self-efficacy in design studios. By doing this study, the researchers hope to better understand the types of design studios, the types of projects, a rubric for assessing a project score, the level of collaboration amongst students in design studio courses, the ability of a student to communicate their designs to stakeholders both inside and outside of the campus community, and its combined influence on student self-efficacy.

ARE THERE REASONS WHY YOU SHOULD NOT TAKE PART IN THIS STUDY?

You should not take part in this study if you have no interaction with College of Design at the University of Kentucky as a result of your involvement with this project.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST?

Your part in the study will take place at the University of Kentucky and will last no more than 2 hours.

WHAT WILL YOU BE ASKED TO DO?

You will be asked to participate in a focus group discussion prior to the beginning of the semester to talk about design studio pedagogy, categorization of studio types, project types, and the ability to use a rubric to evaluate a project score. In addition, the focus group will discuss how students interact with each other, work in design studio, interact with community members (if applicable), and how students communicate their designs. You will then be asked to participate in a one-on-one interview to discuss your current assignment, to categorize your studio type and project type categories, and to provide the researchers with a copy of your studio syllabi (if you have not already done so). At the end of the semester, you will be asked to participate in a post-semester interview. Your participation in this study will last up to two hours over the course of the semester. This time commitment includes a 90-minute focus group and two 15-minute interviews – one at the beginning of the semester and one at the end of the semester.

The researchers will make an audio recording of the focus group discussion and the individual interviews during the study so that so that they can be reviewed from both communication and architectural perspectives.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?

We do not anticipate risks and discomforts beyond those you would normally experience in the course of your daily life and coursework.

WILL YOU BENEFIT FROM TAKING PART IN THIS STUDY?

You will receive no direct benefit from taking part in this study. Your participation may benefit future design student to the extent that our study can help improve design education.

DO YOU HAVE TO TAKE PART IN THE STUDY?

If you decide to take part in the study, it should be because you really want to participate. You will not lose any benefits or rights you would normally have if you choose not to participate. You can stop at any time during the study and still keep the benefits and rights you had before participating.

IF YOU DON'T WANT TO TAKE PART IN THE STUDY, ARE THERE OTHER CHOICES?

If you do not want to participate, there are no choices other than to decline to participate.

WHAT WILL IT COST YOU TO PARTICIPATE?

There are no costs associated with taking part in the study.

WILL YOU RECEIVE ANY REWARDS FOR TAKING PART IN THIS STUDY?

You will not receive any rewards or payment for taking part in the study.

WHO WILL SEE THE INFORMATION THAT YOU GIVE?

We will keep private all research records that identify you to the extent allowed by law. However, there are some circumstances in which we may have to show your information to other people. For example, the law may require us to show your information to a court or to tell authorities if you report information about a child being abused or if you pose a danger to yourself or someone else. Also, we may be required to show information which identifies you to people who need to be sure we have done the research correctly; these would be people from such organizations as the University of Kentucky.

You will be assigned a number during the focus group. We will audiotape the discussion (as noted above), but you will only be identified on the recording and in the transcript by your number, however, confidentiality in the focus groups cannot be guaranteed because other subjects present will know what was said and by whom. The recording will be stored in a password- protected database on a College of Design server and not accessible for public use. Other researchers may submit a request to access the de-identified transcripts, which the project team will review.

When we write about the study, we will write about the combined information we have gathered. You will not be personally identified in these written materials. We may publish the results of this study; however, we will keep your name and other identifying information private.

CAN YOUR TAKING PART IN THE STUDY END EARLY?

If you decide to take part in the study you still have the right to decide at any time that you no longer want to continue. You will not be treated differently if you decide to stop taking part in the study. If you decide you no longer wish to be part of the study, please notify the Principal Investigator of the research team.

WHAT ELSE DO YOU NEED TO KNOW?

There is a possibility that the data collected from you may be shared with other investigators in the future. If that is the case the data will not contain information that can identify you unless you give your consent or the UK Institutional Review Board (IRB) approves the research. The IRB is a committee that reviews ethical issues, according to federal, state, and local regulations on research with human subjects, to make sure the study complies with these before approval of a research study is issued.

The Principal Investigator may contact you in the future to participate in additional studies related to design students' education. Do you give your permission to be contacted in the future by Professor Gregory Luhan regarding your willingness to participate in future research studies about how architectural students interact with community stakeholders to communicate design knowledge?

☐ Yes ☐ No ________Initials

WHAT IF YOU HAVE QUESTIONS, SUGGESTIONS, CONCERNS, OR COMPLAINTS?

Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions, suggestions, concerns, or complaints about the study, you can contact the Principal Investigator Professor Gregory Luhan via telephone at 859.257.6568 or by e-mail: gregory.luhan@uky.edu. If you have any questions about your rights as a volunteer in this research, contact the staff in the Office of Research Integrity at the University of Kentucky between the business hours of 8am and 5pm EST, Mon-Fri. at 859-257-9428 or toll free at 1-866-400-9428.

_______________________________________ ___________
Signature of person agreeing to take part in the study Date

____
Printed name of person agreeing to take part in the study

_______________________________________ ___________
Name of (authorized) person obtaining informed consent Date